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DISEASES OF THE NERVOUS SYSTEM

A PRACTICAL JOURNAL ON PSYCHIATRY AND NEUROLOGY

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DISEASES of the NERVOUS SYSTEM

A PRACTICAL JOURNAL ON PSYCHIATRY AND NEUROLOGY

Electric Shock in Psychosis with Cerebral Spastic Paralysis

PAUL LOWINGER, M.D., and
PAUL E. HUSTON, M.D.
Iowa City, Iowa

In this paper we shall present two cases of psychoses in individuals afflicted with infantile cerebral palsy treated with electric shock. Since a search of the literature on infantile cerebral palsy reveals no reference to the incidence or variety of psychoses in such a group of patients, we may infer that cerebral spastic paralysis with psychosis is a relatively uncommon occurrence.[1-5]

An examination of the records of this hospital disclosed only four cases of psychosis in cerebral spastics out of 9360 first admissions from July 1, 1920 to January 1, 1952. This represents an incidence of .04% which is negligible when compared with 1564 first admissions of schizophrenia, an incidence of 16.60 per cent during this period.

Out of about 5600 patients in Iowa's four state mental hospitals there are 12 psychotic cerebral spastics.[6-9] There are estimated to be 4000 cerebral spastics in Iowa, which has a population of approximately 2½ million persons.[10] The number of psychotic cerebral spastics is about the same ratio to the total cerebral spastic population as the total mental hospital population is to the population of the state. Doctor Winthrop Phelps, who has had extensive experience with cerebral spastics, states that the frequency and types of psychoses in this group are exactly the same as in the general population.[11]

From the Iowa Psychopathic Hospital and Department of Psychiatry, College of Medicine, State University of Iowa.

Two cases of psychotic cerebral spastics were admitted to this hospital before the era of electric shock therapy. The first case was seen in August 1928 and represented a manic-depressive psychosis. She was depressed before admission, but then developed a manic phase. The patient was a 24 year old girl who had a paraplegia since birth with the signs most marked on the left side. This patient gradually recovered over a period of two and one-half years.

The second case was hospitalized in March 1933 and exemplified a manic-like psychosis, characterized by extreme emotional lability, aggressive outbursts, grandiosity and auditory hallucinations. This patient was a 20 year old boy who had a spastic paraplegia since birth. Three years later, after the onset of the psychosis, the patient, though improved, was still confined to another mental hospital.

In both these cases the psychotic content while the patients were excited appeared to compensate for inferiorities related to the cerebral spastic paralysis.

The two remaining cases of psychosis in cerebral spastics seen in our hospital were treated with electric shock. According to a standard reference work on electric shock, this treatment is not contraindicated in certain organic brain diseases including cerebral spastic paralysis, but there are no references to cases of cerebral spastic paralysis so treated.[12]

The first case treated with electric shock was a 26 year old single man, whose illness began in August 1951 with excitability, irritability, restlessness, grandiosity, pressure of speech, and suspiciousness. He was admitted here on September 28, demonstrating elevation in mood, over-activity, pressure of speech and easy distractibility. He gave a rambling account of his recent experiences and was often evasive and defensive. His associations were disconnected and he occasionally uttered irrelevant slogans. He was oriented and the sensorium was clear. His intelligence was estimated as average.

Physical examination showed a man of average height. The positive findings were confined to the right lower extremity. Here there were generalized atrophy, weakness, spasticity, hypertonus, hyperactivity of the tendon reflexes and reduction in alternate motion rate. Abduction of the right hip was limited to 10 degrees. There were well healed scars over the right Achilles tendon and the left thigh. A neurological consultation confirmed the diagnosis of spastic monoplegia of the right lower extremity on the basis of congenital spastic paralysis.

Routine laboratory examination of blood and urine was negative. Electroencephalogram was reported as normal and without focal signs.

The past history recorded the following facts: The patient was born after 7 months gestation, weighing 4 pounds, and was reported by the physician to have a cerebral injury. He did not walk until 2 years and then his mother noticed he was unable to balance and support himself adequately because of a "weak right hip." At 5 years he had a right Achilles tenotomy to correct a deformity of the right foot. An osteotomy at 17 was performed on the left femur to shorten this extremity to permit easier ambulation. He finished eighth grade at 16 after considerable difficulty. His subsequent work record was poor with many jobs held only for a few months each. There was a complete inability to establish any sort of emotional independence from the mother with whom he lived.

He was treated with electric shock three times a week, receiving eighteen treatments. This produced only moderate confusion. Improvement began with the tenth treatment. After treatment, his personality was quite similar to that prior to the present illness. Associations were still somewhat disconnected and there was difficulty in arriving at a goal idea. At discharge two weeks later there was a residual defect related to three factors: his poor premorbid personality, slight remnants of the psychosis and slight recent memory loss thought to be a residual of electric shock. Neurologic examination after completion of electric shock treatment was identical with that on admission.

Admission and discharge diagnoses were the same: manic-depressive psychosis, manic type. Following discharge December 12, 1951 he returned to his prepsychotic level of emotional functioning and held a menial job until November 1952, when another psychotic episode occurred.

A second case treated with electric shock was that of a 31 year old single man. His illness began in January 1947 with a definite change in behavior which included grandiosity, occasional drinking of alcohol, overtalkativeness, and preoccupation with sex. Attention and sleep were poor. On March 26, 1947 he became overactive, excited, extremely noisy and was found by neighbors struggling on the floor with his 66 year old mother.

The patient was admitted to the hospital on March 27, 1947. He was excited, irritable, had a grandiose mental content, and auditory hallucinations. The examiner was recognized by the patient but he was disoriented for time and place.

Physical examination revealed a small man, weighing 102 pounds, with slurred nasal speech. There was a spastic tetraplegia with marked limitation of motion in the lower extremities. The gait was spastic; there were moderate contractures affecting the knees and hips. The reflexes of the lower extremities were hyperactive. The lumbodorsal spine showed lordosis and scoliosis.

Routine laboratory examinations of the blood and urine were negative.

The patient was born August 29, 1915 following a full term pregnancy and a normal labor. His twin died at birth. Incoordination was first noted by the mother at 1½ years and was ascribed to spastic paralysis

due to birth injury by the physician consulted at this time. He first walked alone at 8. He finished sixth grade at 16 with considerable difficulty. He was unemployed until 28 when a rather simple kitchen job was secured for him. He was first seen by the Department of Orthopedics of the University Hospital at the age of 4 when a diagnosis of cerebral palsy was made. To increase mobility of the lower extremities seven operations were performed between the ages of 5 and 18. The Stanford-Binet Intelligence Scale at the age of 24 indicated an I.Q. of 72. A repeat test at 29 was 74.

Following his admission he became noisy, resistive, negativistic, and completely out of contact with reality. He slept and ate poorly. Between April 1 and 14 he received 8 electric shock treatments, making a fair improvement so that he became cooperative, oriented, and lost his delusions and hallucinations. In a week he relapsed and became grandiose, deluded, hallucinated and resistive again. He was transferred to a state hospital on May 6, 1947 with the diagnosis of psychosis with organic brain disease. At this time his neurologic status was the same as on admission. In the state hospital he had recovered from his psychosis by September 1948 with no treatment other than custodial care and was discharged in September 1949. In retrospect, we would consider that this patient was probably undertreated with electric shock. Follow-up indicated that he adjusted at the pre-psychotic level until September 1952, when an acute psychotic episode similar to the first one developed.

Summary:

1. Four cases of psychosis in persons afflicted with infantile cerebral palsy are reported. In the hospital these cases were all characterized by periods of mania which emphasized over-compensatory behavior for inferiorities related to the palsy.

2. The use of electric shock treatment with a definite response in two of these cases is reported. In the first case electrotherapy produced a ten month remission of the symptoms of a manic psychosis. In the second psychosis which resembled delirious mania, electrotherapy produced improvement followed by relapse which was succeeded by a gradual improvement over a 19 month period held for 4 years.

3. In neither of the cases treated with electric shock was there any evidence of change in neurologic status.

4. The level of adjustment following remission of the psychosis in the two cases treated with electric shock was similar to that present prior to the illness.

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A Modification of Carbon Dioxide Treatment Using Nitrous Oxide

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Chicago, Illinois

Carbon dioxide treatment has the unique feature of attacking directly some neurotic symptoms in spite of intentional omission of catharsis and of any symbolic approach to the psychoneurotic symptom. Thus recovery depends only upon the action of the gas upon the brain tissue.

The treatment consists of inducing anesthesia through repeated inhalations of a gas mixture of 30 per cent carbon dioxide and 70 per cent oxygen. During the administration of the gas the patient lies on a bed or on a comfortably padded treatment table. At the first treament, it is advisable to give not more than 20 to 25 respirations. If he does not lose consciousness after 25 respirations, three to five additional respirations may be administered. Further increase in the number of respirations should be determined by the patient's reaction to the gas during and after treatment on that or on the following day.

The 30 per cent carbon dioxide produces a remarkable alteration of almost every nervous activity. It may produce simple rudimentary sensory phenomena; complicated dreams with or without emotional discharge; emotional discharge without any dreams whatsoever; complicated conditions of temporary confusion; hypnagogic hallucinations and intricate cortical and subcortical motor discharges. After the patient has inhaled the gas, respiration is increased and forced, pulse rate and blood pressure increase, and flushing and perspiration may appear.

Some patients lose consciousness at the third or fourth respiration; others only after 15, 20, or more. Between the tenth and the fortieth respirations, indications of psychomotor excitement may be seen which takes varied forms, such as a struggle to escape discomfort or, in some cases, a repetition of some struggle the patient has gone through in life. During the first ten to forty respirations, the lower extremities are flexed at the hip and knee joints and slightly abducted. (This position, in some instances, may be of sexual content.) There is also a slight flexor hypertonus in the upper extremities and, frequently, carpal spasm of both hands.

If the administration of carbon dioxide is continued beyond this phase, between 30 to 50 respirations, adversive seizures lasting a few seconds may appear. During these seizures the pupils react to light. The movements of the patient during this phase resemble bicycling; sometimes they imitate quadrupedal locomotion. At 50 to 60 inhalations, plantar responses disappear, and sometimes Babinski's sign can be elicited. If the treatment is prolonged beyond this phase to the next stage, 60 to 90 or more respirations, the pupils become rigid and decerebrate rigidity develops.

In therapeutic administration of the carbon dioxide we usually do not give such quantities of gas as to produce all the described neurological phenomena. Our first aim is to allow a minimal amount of gas to penetrate the brain, but sufficient quantity to produce a loss of consciousness for two or three seconds. This state of unconsciousness can be achieved by 20 or 30 respirations provided the patient inhales the gas slowly and deeply. Anxious patients are inclined to pant and they, therefore, may need 60 to 100 fast, but superficial, respirations to lose consciousness. These patients have to be trained to breathe the gas slowly.

The sensory phenomena are mostly optical in nature and consist of the appearance of a vague reddish light or small spots in the visual field. These spots, points, or dots, arrange themselves into geometric patterns, or

This paper was presented at the Symposium on Carbon Dioxide Research and Treatment held at Atlantic City, N. J., May 12th, 1952.

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quite often, into elaborate figures with a straightforward or gyrating movement; or they may develop a perspective and become an actual dream. These dreams, in some cases, appear to be open to symbolic interpretation. In other cases, they are so weird and fantastic that they defy description; or the patient may become the subject of an ecstatic condition such as in an epileptic aura or deeply religious experience.

During the entire procedure the patient is free from any danger. Although I have administered more than 40,000 carbon dioxide treatments, I have seen no complications other than one tongue biting and three or four spontaneous urinations. It must be understood, however, that before the patient is submitted to the carbon dioxide treatment, a thorough physical examination should be made. The following somatic contra-indications to the carbon dioxide treatment are known: 1) previous history of coronary attack; 2) organic heart disease; 3) advanced arteriosclerosis; 4) malignant hypertension; 5) high blood pressure (above 180 mm. systolic pressure); 6) emphysema.

I usually give three treatments weekly. The patient can leave immediately after the treatment. The number of treatments necessary to achieve improvement in my group have varied from 20 to 150. If the patient does not experience considerable improvement during the first 20 to 30 treatments I have found that further treatment will not be of help. In many cases it is necessary to experiment with various depths of anesthesia in order to determine the dosage of gas therapeutically most useful for the individual patient. I usually experiment in the following way: On the first occasion I give the patient 25 respirations of the gas. On the next day, I question the patient as to any change in his condition. I repeat the treatment two or three times with the same number of respirations. Then, if there is still no change in the patient's condition, I increase the number of respirations to 30. After repeating this procedure a number of times I am able to establish the necessary degree of saturation with carbon dioxide within ten treatments.

The carbon dioxide treatment is a definite stress on the majority of the patients, both psychologically and physiologically. Psychologically it consists of not only the actual experience of the sensory phenomena during the administration of the gas, but also of the tense anticipation of the treatment. This anticipation is tinged with fear, which in anxiety neuroses may increase to a panic, making the carbon dioxide treatment impossible. These patients would rather terminate the treatment than undergo the trying experience. The greater the anxiety of the patient before the treatment, the greater will be his fear or panic developing during the first introductory phase of the carbon dioxide anesthesia.

To overcome this difficulty a combination of intravenous sodium pentothal, or of phenobarbital and carbon dioxide inhalations has been introduced. The risk in this combination appears to be that barbiturates suppress the medullar sensitivity to changes in CO_2 content of the blood and thus carbon dioxide ceases to be a potent stimulant of the respiration in patients who receive barbiturates. Kauffman and Spiegel demonstrated that after an animal was given barbiturates and then CO_2 it died.

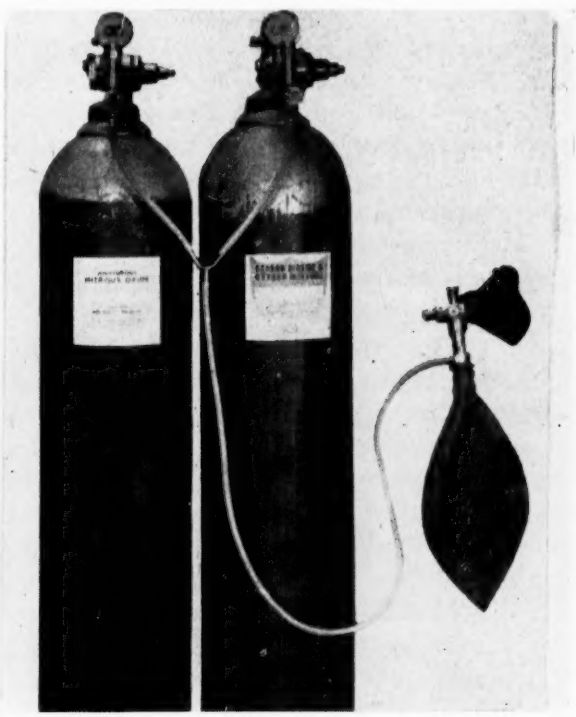

Figure 1.

I have used a method of combining carbon dioxide with nitrous oxide. As shown in Figure 1, a tank of 100% nitrous oxide and

another tank of the 30% CO_2 and 70% O_2 mixture are connected by a single tube which leads to the inhaling bag. In using this combination I do not mix the two gases, but after first opening the nitrous oxide, I apply the mask to the patient's face and let him inhale the nitrous oxide for from 20 to 60 seconds; under no circumstances longer than 60 seconds. We should never forget that nitrous oxide is a more dangerous gas than carbon dioxide and furthermore, during the administration of nitrous oxide an anoxemic state of the brain develops. The blood and the brain, however, contain enough oxygen to carry every individual for 30 to 60 seconds without additional respiration, therefore I do not believe there is any danger in the administration of nitrous oxide for this short period.

During the administration of the nitrous oxide I talk with the patient and ask questions usually along these lines: "Are your legs numb? Is your face numb? Do you still hear me?" When the patient is unable to answer verbally I consider the anesthesia deep enough to switch over to carbon dioxide. During the questioning I do not lift the mask from the patient's face; his voice is audible through the mask. When the desired depth of anesthesia is reached I close the nitrous oxide valve without removing the mask from the patient's face, and turn on the carbon dioxide. From then on I count the respirations and give the requisite number of carbon dioxide inhalations, 20 or 30, or as many as required.

It must be remembered that in any inhalation technique there is at least a seven second delay in the effect. If the patient received 30 seconds nitrous oxide inhalation and the respiratory volume or rate decreased, we need seven additional seconds to see the first effect of carbon dioxide after the carbon dioxide has been introduced into the breathing bag. In this technique, therefore, the patient receives somewhat less carbon dioxide than calculated by the number of respirations. This comes about by the fact that we do not lift the mask from the patient's face and therefore there is still nitrous oxide in the breathing bag at the time we close the nitrous oxide tank and open the carbon dioxide. The patient, therefore, receives a mixture of nitrous oxide, carbon dioxide, and oxygen during the first three or four respirations after opening the carbon dioxide tank.

Based on past experience I do not administer straight carbon dioxide-oxygen mixture in anxiety neurosis at the first treatment. In these cases I start the treatments with the nitrous oxide-carbon dioxide combination. After 15 or 20 combined treatments the patient's anxiety will have decreased sufficiently so that I may try the administration of the carbon dioxide mixture without the nitrous oxide.

In many cases other than anxiety the patients develop a fear of the treatment after 15 or 20 visits. This usually happens when we overtreated the patient; that is to say, we gave a greater number of respirations during a single treatment than he needed. In some other cases the patients developed a fear, not of the carbon dioxide treatment itself, but of horrifying dreams experienced during the treatment.

In these cases I use another modification of nitrous oxide-carbon dioxide combination. My procedure in these cases is as follows: I introduce the anesthesia with nitrous oxide, then I switch to carbon dioxide. When the administration of carbon dioxide is finished, without removing the mask, I administer nitrous oxide again for 10 to 15 seconds. In this procedure, the carbon dioxide is sandwiched between nitrous oxide administrations. The final nitrous oxide administration either makes the patient forget the dream experiences or it cushions the emotional impact of the experience.

In those instances in which we "sensitized" patients to the carbon dioxide treatment because they developed fears during the treatment, after switching over to the nitrous oxide and carbon dioxide combination, my procedure is as follows: First I start the treatment with nitrous oxide then switch over to the carbon dioxide, but I cut down the number of respirations of carbon dioxide to five or ten only and end the treatment with 10 or 15 respirations of the nitrous oxide.

The primary purpose of the entire procedure is to make the patient feel as comfortable during and following the treatment

as is possible. To achieve that end in some cases I give the patient three or four treatments during one session. For instance, if the patient awakens from the anesthesia and is irritable, tense, or fearful after receiving about thirty respirations of the CO_2 with or without nitrous oxide and his emotional state has not calmed down in three or four minutes, I then repeat the treatment by giving only 20 respirations of carbon dioxide with or without nitrous oxide. If this second treatment should still not be sufficient, it may be necessary to repeat the treatment three or four times.

We should never forget that in the carbon dioxide treatment we do not lead the patient; the patient has to lead us. If he is improved and less tense after treatments then we have given the right amount of gas and therefore there is no need to change either the technique or the amount of gas administered. If this should not be the case, however, then we have to change either the technique or the amount of gas until the patient feels beneficial effect.

This treatment is ineffective in the anancastic reactions such as the obsessive and compulsive neuroses and the classic form of hypochondria. It has been established by Loevenhart, Lorenz, and Walters, who studied the effect of carbon dioxide on psychotic patients, that this treatment is of no permanent help in any psychoses. On the other hand, carbon dioxide inhalations make easily manageable a great percentage of patients with conversion symptoms, such as those patients who, without underlying organic pathologic change, create physical symptoms. Also responsive to this treatment are two other groups of patients: Those with faulty control of emergency reactions, such as anxiety neuroses with symptoms of sense of guilt or inadequacy and irritability, and those with personality maladjustments manifested in unconventional behavior and emotional instability.

The diversity of these psychoneurotic conditions helped by the carbon dioxide treatment and the similar variety of cases influenced by an entirely different psychiatric technique, a technique utilizing ether narcosis, preclude our assuming the fashionable psychodynamic explanations as a mode of action of this therapy and force us to speculate about the common features of the pharmacologic processes involved in these different techniques and various chemical agents. Our speculation, however, is based on facts ascertained from experimentation, at least with regard to carbon dioxide and ether; and we have reason to believe that nitrous oxide and the barbiturates work in a manner similar to that in which the first two gases react although, perhaps, by different chemical mechanisms.

Carbon dioxide, we know, produces the following effects on the nerve cells: (1) It increases the membrane potential of the nerve. The increase in the membrane potential is accompanied by a rise of the threshold of stimulation of the nerve; (2) it increases the height of the action-potential and prolongs its duration; (3) it increases the height and the duration of the negative after-potential; and (4) it decreases the fatigability of the nerve cell. Carbon dioxide increases the ability of the nerve to conduct trains of impulses, because the presence of carbon dioxide delays the appearance of the signs of fatigue.

Some of these effects may be reproducible upon administration of ether; Lorente de No, indeed, found this to be so. "In general it can be said that all changes that ether induces in the nerve fibers are a consequence of the changes in the resting membrane potential . . . if consideration is given to the effect of ether upon the membrane potential of the nerve it becomes clear that the changes in the electronic potential and in the threshold of stimulation are in the main a consequence of the changes in the membrane potential. Ether begins its action by increasing the membrane potential."

An increase in membrane potential, regardless of the means by which it is achieved, produces an increased threshold of stimulation with respect to stimuli from both within and without the system thus changed. Of what kind, then, must be the structural organization of any psychoneurotic syndrome that can be influenced by increasing the threshold of stimulation of nerve cells or of nervous circuits involved in the process?

A tentative answer to this important ques-

tion can be given if we think of our nervous system as having an inherent tendency to restore its previous balance or to achieve a new balance after the stimulus which has upset it has ceased. This function of the brain belongs to the order of phenomena we call homeostasis. Homeostasis within the nervous system can be achieved by mobilizing various organizations. It can be achieved by mobilizing suppressive areas, which by negative feed-back circuits, decrease or inhibit the function of the pertinent cortical areas even if the nociferous stimuli persist. Homeostasis can be achieved also by the spreading of the stimulus through many relays to the appropriate motor cortex where adequate action is being initiated in order to arrest the stimulus and, thus, to allay the reverberation of the positive feed-back circuits. The components of this organization are, of necessity, complicated. They consist of afferent pathways to one or several sensory areas, of corticocortical pathways from the sensory areas to the ideomotor cortex, of the thalamic-hypothalamic-thalamic-cortical loops of each of the sensory areas, and finally, of the corticocortical pathways to the motor cortex with its loops through the striatum and probably to the peri-aqueductal gray matter and back to the motor cortex where, finally, the proper action is initiated.

Homeostasis can also be achieved by mobilization of similar or identical organizations through removal of the organism from the orbit of the nociferous stimulus if the stimulus itself, for some reason, cannot be arrested.

It is easy to see that successful homeostasis, which is tantamount to successful living, is a matter of normally functioning negative and positive feed-back circuits. If the threshold of stimulation in any of these circuits is delayed by as little as a few milliseconds, homeostasis cannot be achieved, and a continuous reverberation ensues within the afflicted circuits. The continuance of this self-regenerating function, if it lasts a sufficient length of time, synchronizes neighboring circuits into its orbit; and when the output signals of these have spread to nonspecific effectors, perverse, wayward, interminable reactions are produced, i.e., psychoneurosis.

Which of the nonspecific effectors will be drawn, by synchronization, into the orbit of the primarily reverberating circuits depends upon the threshold values, and thus, upon the resistance of the respective effector system; finally, this resistance, and not the original noxa, is responsible for the symptoms of the psychoneuroses. If the threshold of stimulation of the non-specific ideational system is the lower, an ideomotor neurosis will develop; if the motor system is the weaker, a psychomotor neurosis will develop; if the motor system is the weaker, a psychomotor neurosis will develop; if the autonomic nervous system is the most irritable, a psychosomatic or an anxiety neurosis will ensue. Thus, obsessions and phobias are symptoms of ideomotor neurosis; stuttering, tics, nailbiting, compulsive actions, and grand hysteria are symptoms of parasympathetic or somatic neurosis; and finally, anxiety is the classic symptom of sympathetic neurosis. The illness will commence whenever the threshold of stimulation in the reverberating loops is lowered. *A psychoneurotic condition, therefore, is a disturbance of the nervous net, a disturbance consisting of excessive prolongation of normal function and inducing originally non-affected nervous loops into a synchronous, pathologically prolonged function.* Thus, the existence of a psychoneurosis can be explained by an abnormally low threshold of stimulation with respect to normal stimuli, or by a relatively low threshold of stimulation with respect to stimuli of exceptional strength. In either case, the logical biologic treatment consists of raising the threshold of stimulation to the normal level of resistance to nociferous stimuli from within or from without. Repeated saturations of the brain with carbon dioxide can achieve this end with or without psychotherapy.

Discussion

Question: In the treatments in which you sandwich carbon dioxide between nitrous oxide treatments you said you use a small number of carbon dioxide inhalations. At how rapid a rate do you then increase them?

Dr. Meduna: That will depend on the patient's anxiety. If the patient's fear is too great I do not administer more carbon dioxide to him than five inhalations. Sometimes you need three, four, or five treatments before you can increase the num-

ber of carbon dioxide inhalations. I increase this number usually by five, until I reach the most useful dosage for the patient.

Question: Do you still continue to end the treatment at unconsciousness with carbon dioxide?

Dr. Meduna: There are some of my patients who will not take the carbon dioxide treatment before unconsciousness is produced by nitrous oxide.

Question: Do you feel there are some cases that are benefited even if unconsciousness does not occur?

Dr. Meduna: I have had just two cases who could not take the straight carbon dioxide treatment to the point of unconsciousness. One of these cases benefited from the treatment, the other did not.

Dr. William Harrowes of Edinburgh, Scotland, told me personally of two cases who would not take more than five or six respirations and threw off the mask before unconsciousness developed. He continued treating these patients with the small amount of gas they were able to tolerate and yet he had good results in these cases.

Question: I would like to ask your definition of unconsciousness with the carbon dioxide method.

Dr. Meduna: I cannot give any definition of unconsciousness. A number of times patients told me they did not lose consciousness at all, although I was convinced that the patient did lose consciousness. In these cases I usually asked the patient: "What did you dream?" The strange thing was that the very patient who claimed he did not lose consciousness at any time was occasionally able to relate very intricate dreams. This was certainly sign that even if the patient was not in complete anesthesia he was in an altered state of consciousness; a state you might call hypnagogic. I had a very interesting experience a few weeks ago when a psychiatrist brought a patient for me to give the treatment to in his presence. While the patient was anesthetized a conjugate deviation of the eyeballs developed. Not wanting to talk during the treatment I beckoned to the visiting doctor and pointed to the patient's eyes with my finger. My finger at this moment could not have been more than 5" distant from the patient's eyeballs, the patient was in anesthesia and without consciousness no doubt. When he awakened he told of his dream and then added: "Doctor, there was something else in that dream. Someone, I do not know who, was standing next to me and almost poked his finger into my eyes. I don't know who it was, but it was a big, huge fellow." Well, our patient was unconscious, he had neurological motor discharges, had a dream, and yet he had some awareness of his environment, inasmuch as he perceived my fingers and worked the impression into his dreams.

Question: The end point of the anesthesia seems difficult to determine. It is not as simple as in ether for instance?

Dr. Meduna: No, not as simple as in ether anesthesia.

Dr. Albert Ludin, Springfield, Illinois: I have been treating patients for three years with CO_2 and have treated several hundred patients with many thousands of treatments. I have heard about dreams; however, very few of the patients whom I have treated reported dreams or any geometric patterns. There was only one man who saw colored figures in his coma, but I have not heard this from other patients.

This man was an artist, basically bi-sexual, who had been passively homosexual. He would see colored figures, usually blue and reddish blue, usually part man and part woman.

In the treatment with CO_2 I rarely use any psychotherapy.

From the above it is apparent that it is possibly due to my patient material that I do not have any more dream reports. I practice in the central part of Illinois, and my patients are of a middle and lower middle class. It might be that they are not able to verbalize well.

Dr. Meduna: I believe that the experiences of the patients with respect to the dreams differ so greatly that no general rule can be set up.

For some reason the group of patients I am treating now, which belongs to the middle class, produces less dreams than the experimental group, although that group belonged to a lower economic and cultural level than my present group. I would say that in my present patients of mixed middle class and high middle class population more than 50 per cent have a memory that they did dream something, but they do not know what it was all about. About 20 per cent remembered some fragment of the dream or at least the quality of the dream, whether it was pleasant or unpleasant. Another 20 per cent remembered clearly every minute detail of their dreams. I believe this is an accidental selection with respect to that phenomenon and therefore I would hesitate to arrive at any general conclusion.

Nuvarone (3-Methyl-5, Phenylhydantoin) in the Treatment of Epilepsy

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The anticonvulsant properties of Nuvarone were first investigated by Everett and Richards.[1,2] The drug is highly effective against electroshock and metrazol convulsions in mice. It is a drug of low toxicity as shown by acute and chronic studies in animals.

Favorable clinical results with Nuvarone have been reported by Livingston and Sweet[3] and Peterman.[4]

We have treated a total of 130 patients with Nuvarone at the Seizure Research Clinic of Bellevue Psychiatric Hospital. In 39 cases the treatment was too brief to permit evaluation. Of the remaining 91 patients, 43 were treated for a period of six months to two years, and 48 for less than six months but more than four weeks.

Twenty-five patients were treated with Nuvarone alone. Combined therapy was used for the treatment of 66 of the 130 patients. In addition to Nuvarone, 55 patients were given phenobarbital or Mebaral, one Thiantoin, four Dilantin, five Phenurone and one Tridione. In some instances phenobarbital and Mebaral were administered only at intervals in conjunction with Nuvarone. Seventy-three of the 91 had previous unsuccessful treatments with one or several of the following drugs: Bromides, phenobarbital, Mebaral, Dilantin, Mesantoin, Hydantal, Thiantoin, Phenurone, Tridione, Paradione, Gemonil. The average dose of Nuvarone used was one 0.5 Gm. tablet three or four times a day. The maximum dose given was six tablets (3 Gm.) per day. In a few instances patients were benefited by only two tablets per day.

Of the 91 patients, 44 were males and 47 females. The youngest patient treated was five and the oldest 72 years of age. Five patients were younger than ten, and twenty-five were between ten and twenty years of age.

Thirty-three patients were suffering from grand mal, 27 from psychomotor epilepsy, 18 from both grand mal and psychomotor seizures, nine from grand mal and petit mal, one from myoclonic epilepsy, one from Jacksonian seizures; one patient with paroxysmal EEG pattern had migraine headaches and possibly abdominal epilepsy. Another patient with a paroxysmal EEG was classified as impulsive behavior disorder.

TABLE I

RESULTS WITH NUVARONE IN VARIOUS TYPES OF EPILEPSIES

Type of Seizure	Number of Cases	Degree of Improvement* Good	Fair	Negative	Remarks
Grand mal	33	14	16	3	
Psychomotor	27	15	10	2	
Grand mal and Psychomotor	19	8	8	3	
Grand mal and Petit mal	8	6	2	0	Petit mal not controlled
Other classes*	4	1	2	1	
TOTAL	91	44	38	9	

*Discussed in text.

The results obtained with Nuvarone are summarized in Table I. We arbitrarily considered improvement as "fair" when seizures were reduced by 35 to 75 per cent, and "good" when seizures were controlled 75 to 100 per cent. In the entire group of 91 cases, the response to Nuvarone was good in 44

Nuvarone was supplied by Abbott Laboratories. It is a new drug under clinical investigation and not as yet on the market for public sale.

From Bellevue Hospital and the Department of Psychiatry, New York University, College of Medicine.

patients or 48 per cent and fair in 38 cases, or 42 per cent, which gives a total of 82 improved cases or 90 per cent of the group. In nine cases, or 10 per cent, little or no improvement was obtained. Some of the patients who showed only a fair degree of improvement did not take Nuvarone regularly or in adequate doses. In one instance, the patient developed an aura which had not existed prior to the medication with Nuvarone. In another case, in addition to the reduction in the frequency of seizures, a depressive state seemed to be favorably influenced.

Of the 33 cases of grand mal, 14 showed good and 16 fair improvement while three did not respond. In the 27 psychomotor cases, 15 showed good and ten fair response while two were not benefited. Of the 19 patients with a combination of grand mal and psychomotor epilepsy, eight were markedly improved, eight showed a fair degree of improvement and three did not respond. In eight cases with grand mal and petit mal, six showed good and two a fair improvement of grand mal while the petit mal attacks were not affected. The case of myoclonic epilepsy did not respond. The patients with Jacksonian epilepsy and migraine showed some improvement. The case of impulsive behavior reacted favorably to Nuvarone.

Side effects, which were mostly mild and transitory, occurred in 19 cases, or 21 per cent. Two patients developed a drug rash. One of these was able to tolerate Nuvarone on a second trial (this patient also had a skin rash when taking Phenurone). Two patients complained of itching. Drowsiness, restlessness, or an initial "groggy" feeling occurred in five cases. One patient complained of headaches and another of stomach-ache. One patient had a transient loss of taste. In one case there was an initial slight increase in temperature.

Aside from these mild side reactions which occur commonly with other hydantoins, five patients (6 per cent) developed changes in the blood picture. A mild leukopenia which improved shortly after withdrawing the drug was observed in three patients, one of whom also showed ecchymoses over parts of the body. A slight increase in the polymorphonuclear leukocyte count occurred in two patients but one of these was able to resume Nuvarone medication without further difficulty. A marked increase in urine urobilinogen lasting for several months occurred in one patient who was treated with a combination of Phenurone and Nuvarone. This was probably due to the Phenurone which has been known to produce liver damage. While these side reactions were not severe, they indicate the importance of blood counts and urine examinations at suitable intervals. One case[5] of aplastic anemia presumably due to Nuvarone has been reported.

A 16-year-old girl in a suicidal attempt took at least 14 tablets of Nuvarone, probably in combination with a large amount of phenobarbital. Her urine and stomach contents contained large amounts of barbituric acid. She was unconscious for ten days but recovered without any permanent ill effects.

One 25-year-old patient took Nuvarone during her pregnancy and gave birth to a normal child. Another woman took the drug during the first part of her pregnancy.

A 30-year-old woman who had a toxic skin reaction while on Dilantin tolerated Nuvarone well and the skin rash disappeared after she changed to Nuvarone.

A patient who developed skin eruptions and itching from phenobarbital, dilantin and mesantoin had no side effects from Nuvarone.

The effect of Nuvarone on the electroencephalogram is still under study but it does not seem to cause essential changes in the pattern.

Conclusions

We consider Nuvarone a useful drug in grand mal and in many cases of psychomotor epilepsy. It does not seem to be effective in petit mal seizures. As for side effects, we found most of these mild and transitory. Serious complications can probably be avoided by proper management and frequent blood and urine examinations. In our group it was necessary to discontinue the drug in only a few cases. Unlike Dilantin, Nuvarone does not seem to cause a hypertrichosis, ataxia or hyperplasia of the gums. We believe that Nuvarone has a definite place in

the treatment of convulsive disorders. Although it appears to be more toxic than Dilantin, the therapeutic results with Nuvarone are comparable to and frequently better than with Dilantin.

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The Meaning of Anxiety

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Primitive man related everything to present circumstances; he had no notion of future events. He practiced hunting for the impelling present needs, but not agriculture nor any form of saving to provide for future needs. Only immediate dangers were avoided by him. He experienced fear when frightening stimuli were present but he was not anxious about future happenings. Anxiety came into man's awareness when he acquired a conception of time as the carrier of future events.

The existence of man is essentially finite. Limited by death, his existence is a "being for death." Although our existence is characterized by the fact that there are things possible for us, the moment will come when there will be no more possibilities, when there will be no more ahead of us. This, of course, is the moment of death. It is this fact of our being in a finite and limited time which accounts for the tragic character of anxiety.

We go beyond ourselves toward the future. Each of us is always in front of himself. We are always planning, and we project ourselves into the plan. Man is a being who is constantly oriented towards his possibilities. Man is a being who has to exist. The time of existence begins with the future. Comprehension is always stretched toward the future. It is thus that we are always filled with anxiety and care. We are always concerned with something which is yet to come; and Being, in so far as we seize it in existence, is care and temporality.

Anxiety thus exists essentially as a time element. It is the reaction to a threat to the existence of one's self as a human being, or to the values that one identifies with that existence.

It is well known that every individual tends to reach a level of integration maximal for himself; he seeks to defend the particular level he has attained against any threat or danger, because any lowering of this level constitutes a vital injury to his ego. Accordingly, anxiety may be expected to arise whenever the individual feels threatened not only by actual danger, but by a situation which threatens his personality as a whole.

Anxiety appears when gratification is frustrated. It is because of the frustration that a reality factor, the ego, is born. Hence the ego is born and develops out of the pain of frustration. The antithesis between instinct and anxiety becomes the antithesis between id and ego.

As the organism becomes more complex the reactions of the primitive ego to external reality become more complicated by its having to turn its attention to states of instinct tension which would threaten its freedom from within. It may be torn between adopting reality to suit its instinct demands, and

suppressing instinct demands when these would endanger its relationship to reality. The problem is also complicated by the existence of the superego, which must also be placated in the course of ego adjustment.

Anxiety is the tension or continuing discomfort experienced when reality frustrates the tension or continuing discomfort experienced when reality frustrates the gratification of an urge or desire (the neutralization of a chemico-physical condition). The anxiety leads to an abandonment of the pleasure principle, which is inoperative on account of the frustration, and causes an automatic mobilization of all the resources of the organism to deal with the cause of the frustration. This usually means a concentration of attention upon reality. From this concentration on reality the ego comes into being, and at the instigation of further reality frustrations, it develops. As instinct gratification is accompanied by pleasure, this process of instinct frustration and ego development is accompanied by anxiety. The degree of anxiety will naturally vary from imperceptible faintness, when the ego is in the process of successfully coping with reality and removing frustrating obstacles of instinct gratification, to heightened tension when the ego is failing and frustration is persisting.

Both anxiety and freedom arise from the same capacities of man. The planning function of the nervous system, in the course of evolution, has culminated in the appearance of ideas, values and pleasures. These are the unique manifestations of man's social living. Man alone can plan for the distant future and think ahead. For this reason man alone can be anxious. Anxiety accompanies intellectual activity as its shadow.

The very nature of human living evokes anxiety. Man is always looking ahead of himself. He has to find himself constantly. His future is limited by the fact that at the end there is always death. Thus he moves ceaselessly from his future to his past, from his anticipations and plans to memories, regrets and remorses and this is usually accompanied by anxiety.

Anxiety is purely a human manifestation. Man alone has to make decisions and each decision is a risk. Man is always surrounded by and filled with uncertainty and uncertainty and risk give rise to anxiety.

The human being exists as a mortal; he is the only being who knows, who can know —that he is mortal. It is this inexorable limit, mortality, finitude and death which determines and characterizes man. It is this awareness of his mortality and uncertainty of the future, the constant threats to his career as a human being that is the source of all anxieties.

Dr. Franklin G. Ebaugh Retires from University

Announcement was made recently of the retirement of Franklin G. Ebaugh from the full-time faculty of the University of Colorado School of Medicine after twenty-eight years of service at the School as Professor and Head of the Department of Psychiatry and Director of Colorado Psychopathic Hospital.

This period of service was broken only during World War II when Dr. Ebaugh served as a Neuropsychiatric Consultant to the Armed Forces for which he was awarded the Legion of Merit for distinguished service.

Dr. Ebaugh was graduated from Johns Hopkins Medical School in 1919. Before coming to Colorado in 1924, he served at the Phipps Psychiatric Clinic, New Jersey State Hospital, Philadelphia General Hospital and as Instructor in Psychiatry, University of Pennsylvania and Clinical Professor of Psychiatry at Women's Medical College (1923-24).

He is a member of many scientific and medical societies and has headed such national groups as the Central Neuropsychiatric Association (1930), Advisory Council on Medical Education (1938-1942), Association for Research in Nervous and Mental Diseases (1944), the National Research Council's Committee on Neuropsychiatry (1941-42), National Foundation for Infantile Paralysis (1938-48) and Education Committee of Veteran's Administration (1949 to present).

Dr. Ebaugh's publications number over one hundred. In 1951, with Strecker and Ewalt, he co-authored *Practical Clinical Psychiatry*, 7th edition. His contributions also appear in such books as *Psychiatry in Medical Education, Psychiatry in the General Hospital*, and in *Davis Cyclopedia of Medicine on Alcoholic Psychoses*.

Neurological Clinical Pathological Conference

of the

Cincinnati General Hospital

CHARLES D. ARING, M.D., *Editor*

CASE NO. 280830

Presentation

J.H., a 14-year-old white boy, was admitted to Cincinnati General Hospital at 4:15 P.M. on November 26, 1951, and died on November 28 at 6:15 P.M.

Present Illness: Eight days prior to admission the patient developed an upper respiratory infection and had severe bifrontal headache. Two days later when the illness had not abated, the family doctor was called and administered sulfadiazine "for the flu." The next day he began to vomit and soon after became confused and disoriented. Two days before admission weakness in the right extremities was noted and this became progressively more profound.

Physical Examination: Temperature 102.8°; pulse 88; respiration 24. The patient was an acutely ill young boy, disoriented, uncooperative, and though able to enunciate words, could not put them together in a coherent sentence. There was tenderness to palpation over the frontal sinuses, more marked on the left. The nasal mucous membranes were dry and red with a small amount of seromucinous discharge in the middle meati. The pharynx was mildly injected. There were a few basal rales in both lung fields posteriorly. The optic discs were clearly outlined but the physiologic cups were absent and the retinal veins were found to be full. The pupils were equal (2.5 mm.), round, regular and reacted promptly to light and on convergence. A supranuclear type of facial palsy was apparent on the right. There was flaccid paralysis of the right trunk and extremities, more profound in the leg and thigh than in the arm or face. The deep reflexes were hypoactive on the right side and the superficial abdominal reflexes were absent on that side. A Babinski response was present on the right. Nuchal rigidity and a Kernig's sign were elicited.

Laboratory Findings: A lumbar puncture revealed an initial pressure of 350 mm. H_2O and a final pressure of 250 mm.; the fluid was cloudy; there were 23,000 WBC/cu.mm., most of these being polymorphonuclear leukocytes; the protein was 150 mg. per cent, the sugar 35 mg. per cent and the chlorides 120.4 meq./1. Cultures of the cerebrospinal fluid were attempted but there was no growth.

The peripheral blood contained 14.0 Gm. hemoglobin, 25,000 W.B.C., BUN 12.1 mg., CO_2 19.5 meq./1., and chlorides 97.6 meq./1.

Nasal cultures grew out staphlococcus aureus and non-hemolytic streptococci.

X-rays: Films of the skull revealed marked clouding of the left ethmoid, frontal and maxillary sinuses. The left nares was completely occluded.

Course in the Hospital: The patient was put on gantrisin, chloromycetin, intramuscular and intrathecal penicillin and neosynephrin nose drops. His state of consciousness vacillated from stupor to relative awareness during which he talked to his family. The right pupil became larger than the left and papilledema developed bilaterally. His temperature dropped to 99.2° at one point but rose terminally to 102°. Death ensued when he very suddenly became cyanotic, tachypneic, and minutes later ceased breathing. Stimulants were administered and cerebrospinal fluid removed but to no avail.

Differential Diagnosis

Dr. J. Park Biehl: Occasionally we have to deal with a straightforward presentation in conferences such as these. I believe diagnosis in this case is clear, and I have noted a reference[6] which I believe will aid in clarifying questions that may arise concerning this condition.

This is a problem of an intracranial complication of rhinological disease, in particular, intracranial complication of acute sinusitis. This 14 year old boy evidenced unmistakable signs of acute sinusitis. He had upper respiratory infection and poorly defined headache; he developed tenderness over the frontal sinuses, more on the left, and the x-rays showed sinus disease with obliteration of the sinuses on the left side. More explicitly the sphenoidal sinus was clear and quite large, the left frontal was large and filled with a material that was only slightly less dense than the bone around it. The region of the left ethmoid was clouded, as was the left antrum.

That the infection had spread intracranially is quite clear. Early in his disease the child developed vomiting, a sign which would be unusual in sinus disease. He became con-

fused and disoriented, which condition progressed. He developed a stiff neck, and shortly before he came to the hospital he developed hemiplegia and what appears to be dysphasia, and showed beginning papilledema. There could not be much else to complete the picture except convulsions, chills, and cranial nerve palsies.

In considering the intracranial complications of sinus disease, there are a number of conditions to be mentioned. First of all, exactly how the infection gets behind the sinuses is of some interest. It either can spread by direct invasion of the posterior plate of the frontal sinus, entering the epidural space, and perhaps penetrating through the dura directly to deeper regions, or which is more common, spread via infected phlebitis of the veins which drain the sinuses and go internally. There is a rich network of anastomosing veins which can connect those of the sinuses with the superior sagittal sinus, and by flow internally through these systems an infection can be transported to distant regions. Infections may be carried deep into the subcortical areas of the brain through this mechanism.

The types of intracranial complications include a pure meningitis with no other suppuration and thrombosis of the superior longitudinal sinus. In the case of sphenoidal sinusitus we would consider also a cavernous sinus thrombosis because this venous channel lies over the sphenoidal sinuses. Then, abscess formation in three particular sites may occur within the brain itself, over the dura, under the dura.

That this is not the picture of uncomplicated meningitis is clear. It is present certainly in what appears in retrospect to be a sterile form, yet it's not at all common in the first place for us to see infectious meningitis alone arising from the ethmoid or frontal sinuses. In a series of 103 cases of pneumococcal meningitis in adults, which we have accumulated over the past 10 years, I was able to find 10 instances, that is about 10 per cent of the cases, arising at least in conjunction with acute sinusitis. In those 10 cases the frontals were involved only three times. Therefore, in our clinical, and in some cases pathological, observations, only 3 of 103 cases of pneumococcal meningitis showed concomitant acute infection of the frontal sinuses. Therefore, for this reason and others that I will take up, it is logical to conclude that if frontal sinus disease is demonstrated in a case of meningitis, one should go further than the diagnosis of simple meningitis to explain such a case. Furthermore, this boy apparently had complete paralysis of the right side and dysphasia, indicating an extensive cortical lesion if the basis were meningitis alone. However, meningitis rarely produces such devastating cessation of function of the whole motor strip as appeared in this patient. Occasionally weaknesses of a limb, a Babinski sign on one side, or a cranial nerve palsy will be seen in meningitis but not hemiplegia.

Thrombosis of the superior longitudinal sinus is a rare condition and there is usually sepsis and more spiking fever than is indicated here. Blood cultures are frequently positive. Signs appear bilaterally and pure superior longitudinal sinus thrombosis produces no meningeal reaction. I don't believe that this can be ruled out, but I don't think it is the whole story.

An abscess within the brain is more difficult to rule out. However, it seldom is as fulminating as was the case here. It seldom becomes clinically apparent over such a short period when it arises from an acute sinus infection. The onset in our boy seems to be fairly clearly delineated ten days before death. One would expect a more protracted and benign development with less meningeal reaction. Here the patient developed sinusitis, and immediately became severely ill with intracranial spread of infection, so that he died ten days after the first symptom of sinusitis. This would be quite unusual for a brain abscess alone.

Pus also may accumulate in the epidural space but this is an entirely different matter. It is usually associated with a chronic osteomyelitis of the skull. It is a low-grade infection, commonly a milder complication of osteomyelitis, and it may not be apparent clinically.

I think in this case the pus was located in the subradural space, a favorite space to which frontal sinus disease spreads. It is

common enough so that when intracranial complications of sinusitis appear, particularly frontal sinusitis, one should be aware of this condition and take aggressive steps to treat it. The subdural space is potentially a large space with no firm connections between the dura and the pia-arachnoid. When infection gets in this subdural space it spreads rapidly and a fulminating empyema develops. Kubik and Adams[6] have pointed out that it is actually empyema because the suppuration is present in a naturally closed space. If it were in a space which it excavated itself it would be an abscess. The suppuration appears subjacent to the infected frontal sinus initially, spreads rapidly over the hemisphere, and may extend between the hemispheres and it may even go over to the opposite side. A complicating feature of the infection is the fact that it is also a growing intracranial mass which makes the clinical condition all the more hazardous to deal with. A good percentage of subdural empyemas are cured by surgical drainage and appropriate antibiotic therapy. However, the condition must be recognized early. Clinical cures are difficult to find before the antibiotic era, yet at the present time if the case is recognized early there is no reason why most patients should not survive. Subdural empyema should be suspected early particularly in the presence of sterile meningitis which should lead to the realization that meningitis is not the whole answer, especially when hemiplegia or aphasia supervenes in the presence of acute frontal sinusitis. I think that when any two of these three conditions appear the physician should realize that a surgical procedure will probably be necessary. It's one thing to say now that this is a sterile fluid. How would you know it if you were seeing the patient for the first time at 2 o'clock in the morning? If you could demonstrate healthy looking organisms in a smear you would be much happier in calling this simply meningitis. Also, it is a simple enough procedure to order an emergency sugar determination on the spinal fluid. If the sugar level is not depressed, it can be assumed that the fluid is sterile for clinical purposes.

The surgical approach consists of burr holes over the region where pus is suspected. In this case it would be somewhat behind the frontal sinus on the left. One or more holes can be made as the surgeon sees fit. The dura is observed, and usually will appear pale, as one would expect if there was pus beneath. It is incised and drained.

In intracranial suppuration it is recognized that the field of inflammation is made up of packed white cells, fibrin, and their break-down products. To a large extent the area is avascular, particularly when compared to infections elsewhere such as pneumonia, where the inflammation is enmeshed in a rich capillary bed. In pneumonia avascular barriers are not present, and antibiotics can pass freely and directly into the field of action where they are needed. In meningitis, on the other hand, ordinary doses of systemic penicillin do not easily provide bactericidal levels within the field of exudation. Of course, the pus might disappear in time, but the patient meanwhile would have died. It is our experience in clinical meningitis, as well as in experimental meningitis in monkeys, that suppuration over the brain is poorly tolerated.

To remove this infection more rapidly, it has been proposed[4] that excessive doses of systemic penicillin would provide more effective permeation of the infected field, the infection would be more quickly eradicated, and the suppurative mass would be more quickly removed. The results of this therapy were distinctly better and were obtained without the use of intrathecal penicillin.

In respect to the use of enzymes in debriding the subarachnoid space suffice it to say that streptokinase and streptodornase may be administered intrathecally in cases of purulent leptomeningitis without fear of untoward side reactions. However, it is difficult to demonstrate any resulting improvement.

In subdural empyema the situation is comparable to meningitis in that antibiotics in ordinary doses do not readily reach the field of infection, and we have the problem of the empyema acting as a rapidly-growing intracranial, supratentorial mass. It would seem that massive doses of intra-muscular penicillin would be the appropriate method of treating this patient, in conjunction with surgical drainage. This patient had been

receiving 300,000 units penicillin every 3 hours intramuscularly and gantrisin 1 gram every 4 hours, a total of 2,400,000 units of penicillin daily. This daily total every 3 or 4 hours would perhaps have been more helpful. In addition, penicillin in dilute solutions might be applied subdurally through catheters inserted at the time of surgery.

One might be tempted to use combinations of other antibiotics with penicillin in a situation like this in an emergency. I would try to avoid this. We know little about the bacteriology of this disease, and it would be helpful to know more about the precise identity and behavior of the responsible organism. The published reports contain little more than offhand remarks about the cultures of the pus, usually amounting to Staphylococci or Streptococci, with an occasional pneumococcus or influenza bacillus. Incidentally the nose culture in this case was taken when the nose was already blocked, and two organisms were reported. I think that if we have a pure growth of Staphylococci that it might be significant, but that, since there was a mixture of both Staphylococci and non-hemolytic Streptococci, there was no predominating organism, and we can't rely too heavily on the bacteriological report. If one wanted to add an antibiotic to penicillin in treating such a case, I would suggest that streptomycin would be the drug of choice inasmuch as streptomycin and penicillin never have interfered with the action of one another and in fact at times are synergistic, particularly in certain groups of Streptococci such as enterococci. I would caution against the use of aureomycin with penicillin, since it has been shown clinically[7] that aureomycin detracts from the good effects of penicillin when used in the treatment of pneumococcal meningitis.

What about the cause of death in this boy? It is my opinion that he developed a temporal lobe pressure cone. We spoke of the dangers of a progressing supratentorial mass. When a mass in or over the hemisphere grows, a point is reached where the uncus of the temporal lobe is forced over the edge of the tentorium and presses on the adjacent brain stem, and, in some way which has never been clearly delineated the pupil on the ipsilateral side dilates. That is what seems to have happened here. He developed very sudden tachypna and apnea which sounds very much like a complication involving the brain stem. I would wonder if his pulse continued to beat for some time. This is frequently the sequence in brain stem complications of intracerebral hemorrhage.

Dr. Samuel A. Trufant: This erudite discussion by Dr. Biehl is mirrored in excellent student diagnoses and discussions. Of the student diagnoses, 19 agreed with Dr. Biehl that this was a subdural abscess or empyema. Seven felt that this was primarily an intracerebral abscess in the left frontal region. One suggested an abscess but unfortunately didn't indicate where.

Dr. Daniel Osher: It is important to learn why these patients develop paralysis which is a clue to what is going on and is the signal for prompt intervention. Unfortunately about the time that the paralysis develops, although often early enough to save life, it is too late to save the patient from residual neurological deficit. I don't actually know the explanation for the paralysis. I think that it's probably due to a suppurative phlebitis as well as back pressure on the veins draining an area of the brain, with softening of the brain. This is not necessarily due to direct infection but secondary to venous congestion. This brings up the question of prompt treatment. This condition was practically always fatal in the past. In the last ten years, as was noted by Dr. Biehl, immediate surgical intervention and massive antibiotic therapy, both parenterally and directly into the subdural space, have reduced the mortality rate considerably. I think that in any patient with a story of frontal sinusitis developing acute signs of spread to the central nervous system subdural empyema must be thought of even though at first glance these cases resemble meningitis. If that is not considered it is soon too late to save the patient's life or almost as important, to prevent the residual and permanent neurological deficit that might result. One other point, all of these cases should be treated with bilateral skull openings because most of them have pus on both sides of the falx, even though it is massive on one side. I have treated subdural empyema through a single

opening and a few days later have had to open the other side before the patient came around.

Dr. Morton Hamburger: This boy died within ten days of the onset of symptoms. I would like to ask whether in the series reported by Kubik and Adams death usually was as prompt as this. I would like also to ask about hemiplegia as a complication of intracranial suppuration, particularly as to the time of its appearance. In this boy it occurred early, within the first 3 or 4 days. In another case, which comes to mind, a man in his 30's who had pneumococcal meningitis made a good recovery from meningitis with the conventional treatment of 5 years ago, and then after he was apparently in the clear he developed hemiplegia. We were afraid that he had an accumulation of intracranial pus and possibly a brain abscess, and were astonished when the neurosurgeon refused to operate and made the diagnosis of thrombophlebitis of intracranial veins. Accordingly, the patient was watched carefully and treated further over a period of some days. The hemiplegia disappeared and in time he left the hospital perfectly well without benefit of surgery. With the appearance of hemiplegia associated with intracranial infection are we likely to have to consider this differential diagnostic problem with any frequency?

Dr. Biehl: Hemiplegia in meningitis isn't a specific diagnostic point, but its appearance should alert us. I have no idea about the frequency of the differential diagnosis mentioned by Dr. Hamburger; I believe it to be rare. There were 14 cases in the series discussed by Kubik and Adams, 13 were males and 8 of the 14 were from 12 to 30 years of age. Death occurred in their series from 2 to 5 days after the onset of localizing signs. Many of the sinus infections were a flare up of chronic disease, and it was difficult to date the beginning. Death within 4 days after the onset of hemiplegia is in keeping with the experience noted in the literature.

Dr. Biehl: Hemiplegia, in the reports that I've examined[3,5,8,10,11] is an extremely common occurrence. Why it happens I don't know. There is pus overlying the cortex and beneath it there is suppurative thrombophlebitis, there may be cortical abscess formation or cortical encephalitis.

Dr. Osher: These cases usually go along with what looks like meningitis, and then suddenly develop convulsions or hemiplegia. It appears to be almost of apoplectic onset, and it would seem to be vascular in nature.

Dr. Joseph P. Evans: I might draw attention to the article by Botterell and Drake[1] which reports on intracranial suppuration, including 10 cases of subdural empyema; 7 from pansinusitis, 2 otogenic and 1 from an infected wound. Seven of these empyemas were unilateral, 3 bilateral; 4 were associated with brain abscess. There were no deaths. These authors stress that adequate drainage must be accomplished along with thorough antibiotic treatment.

Discussion of Pathology

Dr. Paul Wozencraft: In a photograph taken at the autopsy table, looking downward into the base of the skull with the dura in place, after removal of the brain, there is seen shiny material which might be taken for light colored dura. Actually it is an accumulation of slightly greenish, whitish pus in the left frontal region. There was a massive exudate remaining after we removed the brain: a left subdural empyema extended backward along the falx and posteriorly to the cerebellar tentorium. Purulent material surrounded the entire left cerebral hemisphere from frontal to occipital poles. There was a minimal amount of pus in the right subdural space in the parietal region. The major quantity of the purulent material was fluid and readily washed away; however, that applied to dural surfaces was tenacious and adherent, and it is likely was that first laid down.

The scalp was diffusely and moderately edematous. When the taut dura was incised on the left, there occurred a copious flow of foul-smelling, purulent material.

All the venous sinuses were opened and examined; there was no thrombosis. The dura was stripped from the base of the skull to reveal healthy bone. The sphenoid sinus was opened and was normal. When the left ethmoid sinus was opened large quantities

of foul-smelling, greenish, yellow, purulent material exuded. The right ethmoid sinus was normal. Of the remaining nasal sinuses only the left frontal contained the purulent material which exuded on its opening.

The autopsy had been begun 2 hours after death. The brain weighed 1500 grams. The cerebral hemispheres showed normal convolutional pattern. The left cerebral hemisphere was slightly larger than the right and the convolutions on the left were obscured by a thick film of purulent exudate which extended along all of the sulci in the frontal lobe over the superior, lateral and mesial surfaces. There was flattening of the convolutions of this hemisphere and marked congestion of the cortical veins. The right cerebral hemisphere showed no exudate and aside from congestion of the vessels, the leptomeninges appeared translucent and normal. Over the left frontal pole there was a very thick layer of exudate which did not extend downward over the orbital surface. The median cleft showed no shift of midline structures.

Viewed from below, the orbital surfaces of both frontal lobes appeared normal aside from the left frontal pole which has been described. There was marked hippocampal herniation on the left side, and there was definite ridging on the right side as well, and the floor of the 3rd ventricle was displaced downward somewhat. The meninges over the base were somewhat thickened, they had largely been removed and where present were not covered by exudate. The brain stem was in the midline and there was no evidence of a Kernohan's notch or a cerebellar pressure cone. The vessels at the base were thin walled and normal in distribution.

After fixation the cerebrum was sectioned coronally at 1 cm. intervals. These sections revealed the tissue generally to be edematous and poorly fixed with the lateral ventricles compressed and almost completely obliterated, due to the swelling. A film of purulent exudate was found to extend along the mesial aspect of the left frontal lobe. Sections made through the brain stem and cerebellum failed to reveal any gross abnormalities.

Microscopically besides the subdural empyema, there was meningitis of massive degree, extending deep into the sulci. The exudate penetrated the parenchyma by way of vessels extending deep into cortex, and there was considerable destruction of cortical structures. We are dealing with an acute purulent meningo-encephalitis; polymorphonuclear leukocytes were packed around congested vessels but were also free in the gray matter. There were areas of edematous rarefaction in the cortex of the left frontal lobe.

The question of thrombophlebitis was raised; we did not find it in this case. In some cases one sees a massive exudation, and little if any thrombophlebitis. We see here (showing slides) vessels involved in the infection, but there is fluid blood in them. On the other hand we may see meningitis, meningococcic meningitis as an example, where we don't expect to find thrombophlebitis, where it turns out to be the chief complication and probably the cause of death. We don't understand these phenomena too well.

The mucous membrane from the sinuses showed both chronic and acute inflammation.

Subdural empyema is a condition that we meet several times a year in our department, a most unhappy situation. It seems to me in the majority of cases, to follow on the ambulatory treatment of sinus or middle ear disease with the sulfonamides. Perhaps this inadequate treatment may mask symptoms to a certain degree, to a point that they are overlooked until the situation gets out of hand. I'd be interested to have Dr. Hamburger or Dr. Biehl comment on this aspect.

Clinical Diagnosis

Meningitis, acute purulent.
Pansinusitis, left, acute.
Abscess, left frontal.
Possible subdural or epidural empyema.

Dr. Biehl's Diagnosis

Subdural empyema (left) secondary to acute purulent sinusitis on the left.

Anatomical Diagnosis

Subdural empyema (beta hemolytic Streptococcus).
Acute purulent meningitis.

Acute cerebritis.

Acute purulent ethmoid and frontal sinusitis, left.

Cardiac dilatation.

Early lobular pneumonia.

Dr. Aring: The mechanism that Dr. Biehl postulated as causing death evidently occurred in this boy. The nurse noted at 6 P.M. that "Respirations ceased. Artificial respirations begun. There is no response." We then find a note that at 6:15 P.M. the heart ceased to beat.

In considering Dr. Biehl's fine discussion of subdural empyema and Dr. Hamburger's comments on thrombophlebitis of cranial veins, I find myself in no small dilemma as to how to proceed at the bedside. We might theorize about the early handling of such patients. As Dr. Wozencraft has said, we rarely see these patients soon enough, though with this boy I have the feeling that we could have saved him, even though we had but 50 hours. Could we perhaps administer massive doses of penicillin early, and if response is obtained as must have occurred in the man mentioned by Dr. Hamburger, all well and good, but if improvement did not occur promptly, we could move with alacrity, surgically? I wouldn't expect the hemiplegia to remit promptly, but I should expect improvement as far as awareness is concerned and perhaps in the vital signs. We are not often faced with the problem of differentiating thrombophlebitis following on acute intracranial infection and subdural empyema. As far as I'm concerned, this is a hypothecated course of therapeutic procedure, and as Wilfred Trotter said, "The only danger of a hypothesis is a too passionate attachment to it." It is all right to make theory as long as we remain mentally alert and agile and able to shift ground promptly.

Dr. Evans: It was a very astute diagnosis of thrombophlebitis of cerebral veins made by the neurosurgeon in the case described by Dr. Hamburger. Obviously the risk is great in waiting in cases such as this. Collections of pus have to be drained, particularly in and about the central nervous system, because the problem of space occupation and shift of midline structures with their deleterious effects are so hazardous to health and indeed to life. The basic surgical principle must be maintained that drainage is imperative. Antibiotics are essential but must not delay evacuation of localized purulent accumulations.

Within the last 6 months we had to deal too late with a subdural empyema in a woman who had been given antibiotics for sinusitis. She became confused, locked herself in her apartment for two days and when the door finally was broken down she was hemiplegic and in a desperate state. We drained that subdural empyema some 4 or 5 days after the onset of her acute difficulty but it was too late to accomplish anything. The problem is much the same as in subdural hematoma. The shifting of midline structures cannot be tolerated. When the deleterious effects of infection are superimposed, we deal with an even more difficult problem.

Dr. Biehl: In connection with the early recognition of this condition, we might reiterate a few points. Acute frontal sinusitis is common enough and we can't watch them all as closely as would be desired. There are a few things that would be worth watching out for in recognizing as early as possible the signs of intracranial complication. Probably the most common complication of acute frontal sinusitis is subdural empyema. So that if one finds signs of intracranial extension with frontal sinus infection, the patient should be sent to the hospital and watched closely, and seen by a neurosurgeon. Some of the symptoms and signs suggesting extension into the intracranial space have been listed by Maxwell[9] as follows: extensive swelling of the forehead, glabella and lids; generalized headache as contrasted to a local headache; vomiting; change in sensorium; visual disturbances, cranial nerve palsies; convulsions; chills and fever. Acute sinusitis ordinarily doesn't produce chills nor a very severe leukocytosis. Other criteria are leukocytosis, say over 20,000; sinus condition better but the patient worse, and signs of increased intracranial pressure. If we are aware and alert we needn't await the occurrence of hemiplegia to initiate vigorous therapy.

Dr. Kurt Tschiassny: The diagnosis of intracranial complications subsequent to sinusitis is missed too frequently. In a monograph by Scandinavian Otorhinolaryngologists[12] it is reported that from 1905 to 1920 there was a mortality of 92 per cent in rhinogenous cerebral abscesses at the Kommune Hospital in Stockholm. With operation the results were slightly better. In 25 per cent of cases the diagnosis of rhinogenous intracranial complication was missed. That should not be. In a case such as this boy's, where there is pansinusitis, particularly when it is corroborated by x-ray and cerebral complication, surgery should have been attempted although I am doubtful whether any surgical procedure would have changed the final outcome in this case. In my clinical experience I have had the impression there's nothing more salutory than learning from mistakes. I have made a lot of mistakes in my life, also I have learned a little.

Dr. Aaring: It was only last week that one of the students asked me what I thought was the purpose of clinical pathological conferences. Without hesitating, I said that their primary purpose, as all teaching exercises, was to allow him to identify with us. We make mistakes, we have the stature to admit them, but then we should take that most important step in the process, which is to benefit by the mistake and not repeat it.

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PROCEEDINGS OF THE FIRST ANNUAL MEETING OF THE HOUSTON NEUROLOGICAL SOCIETY

William S. Fields, M.D., Secretary

Functional Organization of the Cerebral Cortex

Gerhardt von Bonin, M.D., Professor of Anatomy
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Afferent messages are sent to the cerebral cortex from the sense organs and from some deeper parts of the brain. The sensory messages arrive in well-defined regions, (e.g. striate, postcentral, supratemporal area), the stimuli picked up by the sensory cells are "filtered" or "coded" by two or more relay stations in the thalamus and at lower levels. Numerical data support this conception: In the optic sector, to take one example, there are about 1,000,000 units in the retina, there is a slightly larger number of units in the lateral geniculate body, but there are many millions of cells in the strate area.

The cortex receives "unspecific" afferents from certain parts of the thalamus, which perhaps relay impulses originating in the reticular substance of the brain stem (recruiting response?). Certain parts of the cortex receive afferents from thalamic nuclei, such as the medical nucleus, the pulvinar, etc. which do not appear to be concerned with the state of the outside world.

To understand the intrinsic functional organization of the cortex, it is expedient to subdivide the cortex not into lobes but into "sectors," each of which receives its specific afferents from a given thalamic nucleus.

Architecturally, three major cytoarchitectural varieties can be recognized: the eulaminate, the agranular and the "koniose" variety. The differences in density and size of cells, as well as in the thickness of the various laminae, suggest that in the koniose variety the thalamic messages play a paramount role in determining the pattern of cortical activity, that in the agranular variety cortico-cortical messages are the most influential ones while in the eulaminate variety a balance between cortico-cortical and thalamic afferents is achieved.

The cortex forecasts future events in the outside world, and programs the activity of other parts of the nervous system, including the spinal cord and its motor neurons. To achieve the latter end, pyramidal and extra-pyramidal systems work together, in a manner which requires further elucidation. The pyramidal fibers end on many more levels of the cord than the simple diagrams of our textbooks would make us believe, and the simple idea of representation of muscles in the cerebral cortex is untenable. It still remains a problem how the fluid, only statistically determined, events in the cortex can induce the precise order of firing of the lower motor neurons.

Discussion:

Dr. Hebbel E. Hoff: It is difficult to discuss Dr. von Bonin's paper in terms other than of frank admiration, for it is truly a delight to hear a paper as expressive as this is of the spirit of classical neurophysiology. Indeed this paper reminds us of the fundamental objective of neurophysiology to unify form and function, and recalls Sherrington's immediate appreciation of the morphological studies of Cajal. It illustrates Sherrington's insistence that the central nervous system is built upon the twin pillars of afferent and efferent neurons and represents in magnification the fundamental properties of the segmented reflex arc, with a vast expansion of the scale of time and space. Three points particularly have interested me in Dr. von Bonin's paper: (1) His insistence that the neurone is not a simple telephone receiver or transmitter. Even without the recurrent circuits which his school has done so much to study we must recognize the neuron as an actual or potential autorhythmic system regulated by afferent stimuli in a negative or positive way and not a mere passive instrument. (2) The growth in importance of the internuncial neuron, as corticalization progresses, and the need for more study of cortical synaptology. (3) In the motor system Dr. von Bonin has steered a fairly safe course between Fulton's purely motor pyramidal system and Walshe's neogalenical and totipotent pyramid.

Dr. Donald Duncan: There is the work of Ruch and Wang which suggests that if stimulation is sufficiently precise, single muscle and vene single muscle units may be caused to contract.

Meeting held at Methodist Hospital, Houston, Texas, February 8th-9th, 1952.

The Neurophysiological Substratum of the Sign of Babinski

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Conventionally the sign of Babinski is catalogued with the flexor reflexes, in the general category of withdrawal responses to nociceptive stimuli. While the flexion of ankle, knee, and hip which may accompany the reflex is indeed a part of the nociceptive flexion reflex classically described in the decerebrate or spinal cat and dog, in these preparations the toe response is invariably one of flexion and adduction instead of extension and fanning as seen in the sign of Babinski in man. In this dilemma recourse is usually had to argument that flexion and extension have a different biological significance in the human and mammalian foot, or to assertation that the Babinski response is a human reflex having no mammalian counterpart.

Studies on a large number of "low" decerebrate dogs and cats in which decerebrate rigidity is practically non-existent reveals a response in both fore and hind limbs which is closely comparable to the sign of Babinski and which is proposed as its mammalian prototype. It consists of dorsiflexion or extension of the toes, with definite although not always pronounced fanning, produced by light stimulation of the skin and hairs over the sole of the foot. The most active zone is around the dewclaw in the forelegs, and between the toes and around the toe-pads on the hind limbs, although the reflexogenous zone may spread widely, particularly after morphine. With strong response there is generalized limb withdrawal in addition. The response is replaced by the typical flexion reflex when more vigorous stimulation is employed, such as pinching or pricking, and it must be considered therefore as a separate response not related to the classical flexor reflex.

It is concluded that a mammalian prototype of the Babinski response does indeed exist, that it represents a withdrawal response to touch, and that it is not related to the nonciceptive flexor reflex.

Discussion:

Dr. Duncan: Lower animals cannot hold anything painful. They have to extend the foot in order to get rid of the noxious element. Their whole response is "flexor."

Dr. Hoff: I think this is putting the cart before the horse to accept the view that the Babinski response is a flexor one. It is based on none of the far-fetched explanations of a difference between the mammalian and foot, but on the fact that the reflex in animal which mostly fits is the flexor response. Why bother to make such a long round-about explanation when you can pick another reflex which fits more perfectly?

Electron Microscopy of Nerve Cells

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Up to the present time the results of electron microscope study of nerve cells are in part confirmatory of an ultra-structure determined by other methods; in part subject to sharp differences of opinion both as to validity and meaning; and to a great extent uninterpreted by anyone. According to all accounts the myelin sheath is constructed of concentric layers of alternate high and low electron density. The electron microscope pictures approximate but with one possible exception fall short of a clear demonstration of an orderly and uniform distribution of lipoid and protein in alternate layers of molecular dimensions. Instead the protein component in most studies is shown as continuous sheets and the lipoid as discontinuous small flecks and granules. Some workers describe a thin membrane, the axolemma, separating the myelin from the axis cylinder; others see no signs of such a structure. The cytoplasm of the nerve cells, including that of the axon, has been pictured and described as containing neurotubules by some, as filamentous by others, and as essentially formless by still others. Evidence for the existence of neurotubules is incomplete at the present time since such structures have not been clearly seen in undissociated material. Exceedingly fine filaments, down to 100 Ängstrom units in width, appear in most pictures of material fixed in formalin and in some osmic acid preparations. In the axon and in the dentrites these filaments run longitudinally; in the body of the cell their arrangement, if any, is haphazard. Since the filaments vary in width, divide, and coalesce they are probably not unitary structures but aggregates of still smaller elongated particles. In formalin-fixed material the characteristic clumps of Nissl substance are are seen as aggregates of very small rounded particles 00-800 Ängstrom units in diameter. The size of the clusters varies from those visible in the light microscope down to single scattered unit particles. From this it is evident that only a portion of the Nissl material actually present is seen by ordinary methods. In chromatolytic cells the particles are more dispersed, seemingly less dense and less well defined, but not absent. In many chromatolytic cells submicroscopic hyalin sperules are present. Electron microscope information on the cell membrane and synaptic endings is very incomplete.

Discussion:

Dr. Nowinski: DeAlbertus and Dr. Duncan agree perfectly. The question arose what was inside the cell and what outside. DeAlbertus used the tissue culture material. At the end of the growth area the nerve fibers are extremely thin and can be studied with the microscope without staining. He found neurotubules and ends of the tissue fibers. He decided to study the nerves in the unicellular organisms. This question I think is still open and I think the other one is not yet published, but will give support to DeAlbertus.

Dr. Pomerat: I am reminded of the meetings which were held in 1947 in Stockholm, the first large congress of psychiatrists after the war. It was highly significant with new reports of the use of the electron microscope, analyses of ultra-violet, and x-rays, and so on, and Astbury of Leeds said that at long last the worlds of biology and of physical chemistry and coming together. Morphology is a very large science with room for unions of the biologist worker and the physical chemist. The investigator runs certain risks of difficulty of interpretation, but nonetheless the future of medicine, of biology in general, will need to include a great deal of this kind of material. We are fortunate to have workers who are willing to get into this field and explore it. We see in the subject of the axote of the virus the fine work for the nervous field. Much will emerge from this kind of study.

Enzymes in the Cerebrospinal Fluid

Wiktor W. Nowinski, M.D., Associate Professor of Biochemistry and Neurochemistry, University of Texas Medical Branch, Galveston, Texas

Milestones in the investigation of CSF since Catagno (1764) have been: the development of the technique of lumbar puncture by Quincke (1891), the description of cellular elements by Sicardi and his collaborators (1901), and the demonstration of changes in protein content of the CSF in neurological diseases and whose consequence was the colloidal gold reaction (Lange 1912). Since then, thou-

sands of papers have been published on the chemical composition of the CSF. However, as a diagnostic medium, the CSF is as yet far less useful than blood.

The development of enzymology raised hopes that the enzyme content of the CSF might be utilized for the diagnosis of nervous and mental diseases. It was found, for instance, that in meningitis, the amylase activity is increased. In our work, we have been particularly interested in determining whether there are differences in enzymatic activity in mental diseases, particularly in Schizophrenia: this project has been carried out in parallel with clinical investigations conducted by Dr. Jack Ewalt. We have been unable to find any significant differences in proteolytic activity and in alkaline and acid phosphatases in the CSF of Schizophrenics, as compared to neurotics and hysterics. We have reached the conclusion that the enzymes in CSF are derived from the blood rather than from the brain, an assumption first stated by Kaplan, Cohn, Levinson, and Stern (1940), and supported recently by Colling and Rossiter (1950). Further support for this assumption is the fact that the majority of the enzymes present in the CSF are also present in serum. Furthermore, we have been unable to demonstrate the existence of enzymes acting solely in the nervous system, and not present in the blood (carbonim anhydrase, adenosinetriphosphatese, etc.). It seems therefore futile to study the enzymes in CSF for diagnostic purposes in nervous and mental disturbances.

Discussion:

Dr. Jackson: I wonder whether actual sections might yield a little more fruitful information?

Dr. Duncan: The idea of cell death being at a higher than normal rate in schizophrenia can conceivably be compared with the rate of a higher loss of neurons than normal. I had the impression that Dr. Nowinski had some interest in catatonia.

Dr. Nowinski: This is a question which I actually intended to bring up myself, but I don't know whether our methods are not too crude for the very fine instrument that the brain is. I do not want the type of experiment which my colleagues do. Actually if we make a mess out of the brain, it isn't brain at all. I do not like to contribute to the extension of this mess. However, I had in mind this type of work, and am still looking for a method to investigate the brain, and brain cortex as brain cortex. There have been so many unreliable results published that I think more caution should be taken before more are published. I am not convinced at all that this is a significant feature and were I at the verge of a discovery, I would make a tentative conclusion rather than a positive one.

Epizootic Cerebro-Spinal Nematodiasis: Focal Encephalo-Myelomalacia of Animals in the Orient Caused by Immature Nematodes (Setaria Digitata): Does This Disease Occur in Man?

J. R. M. Innes, M.D. (Foundation of Applied Research, San Antonio, Texas) and Chusaburo Shoho, D.V.M. (formerly working at the Institute for Infectious Diseases, University, Tokyo.*

Summary

A seasonal, epizootic,acute, or subacute, clinical neuroparalysis of sheep, goats and horses has been known to occur for years in Japan, Korea and Ceylon (goats). The neuropathology is characteristic. The lesions are dissimilar to any cause by viruses, bacteria, protozoa and fungi, or by toxic or deficiency factors. The process is a focal malacia proceeding to liquefaction and sometimes cavity formation, and with a haphazard-like distribution of the lesions in the central nervous system. The kind of lesion—representative of this disease now called cerebro-spinal nematodiasis—is consistent with the concept that it is essentially traumatic in origin caused by a wandering worm. This is supported by observations on experimental needle-puncture trauma of the spinal cord and on compression myelopathy. A condensed account was given of the work done on the etiology by the Japanese workers since 1939. This disease has been proved by direct observation and by experiment, to be caused by immature nematodes (*Setaris digitata—natural host* cattle). The causal parasites are transmitted as larvae by mosquitoes to *unnatural hosts,* where they develop, migrate and finally invade the nervous system. There is circumstantial evidence that the same disease has occurred in other animals in areas remote from the Orient. It is thus tentatively suggested that the same, or an analogous, disease may have occurred in man, and may have been confused clinically with other paretic conditions, or that it has evaded true recognition in pathological studies. Some suggestions are made in this direction, particular attention being drawn to a somewhat parallel observation in the recent identification of nematode opthalmitis of children in the U.S.A. by Wilder.

Discussion:

Dr. Walker: We have had some unexplained cases in the past couple of years; one was of a man with brain disease tagged with the vague and unsatisfactory diagnosis of encephalitis. The only positive finding prior to death was eosinophilia in the spinal fluid. The smears showed a moderate plieocytosis. On autopsy nothing was found in the nervous system. We just set that aside for about two years; then a case came under observation of myelopathy.

We thoroughly investibated this myelopathy and arrived at no definite diagnosis, but again, eosinophilia was present. In discussing this case with others, I found nothing was known of eosinophilia in the spinal fluid. There never was any satisfactory explanation.

Dr. LaLonde: I wonder if in Japan this worker has observed any cases. I wonder if any skin test has been devised.

Dr. Innes: Dr. Soniat mentioned four cases in 1942 of four male friends fishing in Florida. During that time they drank a great deal of whiskey and much water from the pond. All became paraplegic and one died. The remaining three were still paraplegic in 1948. Dr. Schumacher in, in Vermont, also had a case. As for human cases in Japan, there are quite a number of facts that now the populations are quite normal. All animals mentioned were imported into the country. Everything gets the label of encephalitis over there, both in the Japanese and the Americans in occupation. We must look into the pathology of these things. In many of the cases the diagnosis was not confirmed. Scovel in 1928 described cases of Japs with naked eye cavitations. We know of no disease in humans where you get cavitations by naked eye.

Temporal Lobe Seizures. Considerations on Their Surgical Treatment

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Ninety-eight percent of patients with an anterior temporal focus, show a psychomotor type of seizure clinically. During these episodes the patient un-

*Aided by grant from National Multiple Sclerosis Society, New York, New York.

consciously performs apparently purposeful or coarse movements, many times ending in a generalized tonic or clonic convulsion. In accord with the electrocorticographic findings there appeared gustatory and olfactory phenomena when the cortical focus extended toward the hypocampus and uncus. Perceptual illusions, aphasia, deja-va, auditory and visual disturbances were noted when the focus extended to the second and first temporal convolutions. Usually, when the focus was found well localized in the tip of the temporal lobe the patient had shown some sort of epigastric sensation described more frequently as fear.

The pattern of attack changes from one case to the other. Certain amounts of Jacksonian component may follow, but more ofte a generalized tonic contracture and convulsion ensued.

Once the clinical study of a patient suggest the possibility of a psychomotor seizure, a temporal lobe epiletogenic ocus should be looked for by all means, although the focus has, exceptionally, been found in the frontal or parietal lobe. If routine EEG's are negative, using both ears as a reference electrode, they should be repeated under sleep or Cardiazol activation and even under special basal electrode procedures. We have made serial EEG's in these cases and learned that abnormal activity may show once in many times, this is particularly true when the patient has taken some anti-epileptic drug fro some time.

The temporal lobe is a frequent locus of focal abnormal activity in epilepsy. The fact that the electroencephalogram reveals a dysrythmia in a circumscribed area of the cortex is not enough to denote this place as the epileptogenic focus. The definitive criteria should include the careful analysis of the clinical data, neuroradiology (pneumoencephalogram, angiogram, etc.) and accurate EEG technique.

In 12% of 500 epileptics, the abnormal activity of the cortex involved the temporal lobe. Apparently cases with bilateral synchronous discharges or a widespread unilateral focus extending to the neighbor lobes are not suitable for surgery. Probably the electrically ideal case is the one that shows a unilateral anterior temporal discharge, although a median temporal focus occasionally gives an excellent result upon removal.

We believe that at least in some instances the abnormal focal activity that brings about the psychomotor attack is a reversible condition that may disappear after the removal of the specific etiology without disturbing the cortex.

Histologically we have been able to demonstrate a definite atrophy in five of the 14 operated cases. Three had tumors (Ganglioneuroma, meningeoma and astrocytoma), the rest did not reveal any pathological changes in the removed cortex. Unfortunately, except in the case of neoplasms, the pathological conditions that usually cause psychomotor seizures are not easily circumscribed, if at all, and the most effective way of suppressing the symptoms is by removing the dysrythmic cortex.

Meningo-Uretero Anastamosis

Robert Dean Woolsey, M.D., St. Louis, Mo.

Since the publication of Matson's report in 1949 of a meningo-uretero anastamosis with a polyethylene tube for the treatment of communicating hydrocephalus, we have applied this therapeutic measure in 18 cases. At the present time, seven of these patients are alive and 11 are dead. These two groups of patients are summarized in Table 1 and Table 2.

TABLE 1

DEATHS—ELEVEN

1. Pneumonia	7	Lived from 2 wks to 1 yr. (Average 5 mos.)
2. E. Coli Infection	1	Lived 1½ yrs. after operation
3. Chemical Death	1	Died after administration of 5% saline I.V. instead of glucose for U.R. infection
4. Operative Death	1	Received too much blood on operating table and developed pulmonary edema
5. Cause Unknown	1	Died at home after 1 yr.

TABLE 2

ALIVE—SEVEN

Case	*Function*	*Development*	*Elapsed Post-Operative Time*
1.	Poor	Poor	2½ yr.
2.	Good	Good	1½ yr.
3.	Good	Good	1½ yr.
4.	Good	Fair	2½ yr.
5.	Good	Fair	2½ yr.
6.	Good	Poor	1½ yr.
7.	Good	Good	3 mos.

These babies become dehydrated very readily postoperatively, and sodium chloride must be added to their formulas in order for them to keep from becoming progressively dehydrated. When these babies develop upper respiratory infections they tend to become dehydrated very rapidly, and in most cases in our experience this dehydration has been irreversible with death occurring before arrival at the hospital or shortly thereafter. The families should be warned that at any sign of infection the child must be taken immediately to the doctor. The family physician must likewise be warned to treat such upper respiratory infections with a great deal of respect.

The one patient that was given 5 per cent saline had developed an upper respiratory infection and had been, up until that point, one of the best results that we had. This child had a meningocele and was developing hydrocephalus, and we did a meningo-uretero anastamosis with removal of the meningocele at one sitting. This might not seem entirely correct surgically in view of the fact that an Arnold-Chiari deformity is usually present in such instances. Nevertheless, we have used it in three patients, one of whom did very well. We have had only one infection which presumably ascended from the bladder.

In Table 2 it will be noted that the function of the anastamosis is good in all but one instance, and this was likewise in a patient who had a large meningocele associated with hydrocephalus. Development would be considered good in three patients, and fair to poor in the other four.

This leads to the conclusion that the treatment of hydrocephalus will always be discouraging, because even when the head stops growing, the mentality is likely to be affected.

Discussion:

Dr. Bradford: I think that this is a very promising procedure I would like to ask if Dr. Woolsey thinks that there was more to the cause of death than just the omission of the saline administration. Spinal fluid contains all the elements except protein, so we are loosing more than saline, and in a crisis it must be the depletion of all the elements.

Dr. Woolsey: One child did well with the exception of sudden crisis. We wouldn't consider that pneumonic infections didn't play any important part. CO_2 combining power down around 12 or so. This patient died while on the Pediatric Service in the hospital and there was no postmortem, so we considered it a chemical death.

Dr. Greenwood: Several times in encountering this condition I have run out of things to do, and have tried everything except taking a kidney. A surprising thing is that of the choroid plexectomies we did, three children are in school and making good grades with the hydrocephalus entirely under control. We are not seeing communicating hydrocephalus any more, and I wonder if the antibiotics have cut down on this. I think Dr. Woolsey's is one of the better answers if you can exclude the chemical defects which occur in circulation.

The Diagnosis and Treatment of Tumors of the Glomus Jugulare

Ernest Sachs, Jr., M.D., Assistant Professor of Neurosurgery, Tulane University School of Medicine, New Orleans, Louisiana

The pathology, the clinical behavior and the characteristic signs and symptoms of tumors of the glomus jugulare are presented. Analysis is made of 31 cases previously reported in the literature and three new cases are added. The glomus jugulare is a small paraganglionic structure situated in the adventitia of the jugulare bulb in close proximity to the floor of the middle ear or along the tympanic ramus of the 9th cranial nerve. Histologically it resembles the carotid bodies or the aortic bodies and it gives rise to tumors which are almost identical to carotid body tumors. These are called nonchromaffin paragangliomas. Symptomatically the patients usually complain of deafness, noise in the ear, pain, a discharge from the ear or a facial paralysis. The clinical examination usually reveals a reddish pink vascular mass in the external auditory canal which resembles the common aural polyp. It is extremely vascular. Multiple cranial nerve signs may be present. X-ray examination, as a rule reveals either a clouding of the mastoid antrum or an erosion of the mastoid and the petrous portion of the temporal bone. In about one-fifth of the cases the symptoms are those of a posterior fossa tumor. The tumors are usually benign. They do not respond well to x-ray treatment. Surgical therapy is discussed.

Discussion:

Dr. Hauser: Do they have headaches?

Dr. Sachs: Very seldom.

Dr. Pollard: I had a case a year ago. Her condition is unchanged now, as far as cranial nerves. She is comfortable. The 7, 8, 9, 10 and 11 cranial nerves are affected. There was practically total obstruction of the mastoid with extension through the occipital part. This tumor was removed from the posterior fossa and was 5-6 cm. in size. It provoked very profuse hemorrhage. A subtotal resection was done. The cranial nerve paralyses are the same as preoperatively.

Dr. Alvin Rix: The patient Dr. Sachs, Jr. referred to, was our first case of a non-chromaffin paraganglioma intracranially. We subsequently had a second case. The first case which Dr. Hermann had previously reported was in an elderly woman and surgery was resorted to primarily for relief of pain at the fifth nerve. The nerve was cut by the intradural approach in the temporal fossa and part of the tumor was seen there and biopsy obtained to verify the true nature of the lesion. A few years before a general surgeon had carried out ligation of several neck vessels because of the bruit associated with her tumor. The bruit continued almost unaltered.

Our second case was a 55 year old white male admitted to the hospital in January 1952. His first symptom was hoarseness which had developed eleven years previously. He had difficulty in swallowing for the past five years. He had noted marked reduction in hearing of his left ear for four years. He had noted tingling in his left arm and leg for the previous one year.

There was a moderate weakness of the left facial nerve of peripheral type; there was almost complete hearing loss in the left ear with a dead labyrinth in response to caloric test on the left. There was weakness of the muscles of the left pharynx and paralysis of the vocal cords. In addition the patient had a loud bruit heard best in the region of his left mastoid. The bruit could be completely stopped by compression of the carotid artery on the left side. The ear, nose, and throat consultant reported that the left eardrum was reddish in color.

Doctor Wilkins carried out a left unilateral suboccipital craniotomy which revealed a large tumor in the region of the jugular foramen on the left. The tumor extended upward to the internal auditory meatus and ended at about one cm. short of the crest of the left petrous ridge. Tumor extended to the midline or beyond anterior to the brain stem. It was felt that the tumor could not be removed surgically but a biopsy was obtained in spite of profuse hemorrhage controlled with difficulty. Pathologically this tumor under the microscope was characteristic of non-chromaffin paraganglioma. Postoperatively the patient had a satisfactory course and was able to swallow somewhat better. It was planned that the patient subsequently have X-ray therapy, although we have little hope that it will bring about any considerable improvement. Certainly these tumors are inoperable when they reach a tremendous size. With the help of ear, nose, and throat consultation it may be possible that most of these tumors can be diagnosed before they reach such an extreme size and removed while they are still reasonably small.

Pubertas Praecox with Verified Hypothalamic Lesion

James C. Walker, M.D., Temple, Texas

Clinical evidence seems to indicate that insofar as the central nervous system is concerned, the precocious development of puberty is due to lesions of or about the hypothalamus. The mechanism apparently is not known. Cases of verified hypothalamic tumor associated with pubertas praecox have only infrequently been reported; and very few accounts have appeared in the literature concerning verified hypothalamic lesions associated with precocious puberty in female children. It seems of interest therefore to record a case illustrating the apparently successful treatment of an hemangioma of the third ventricle of the brain in an 11 yr. old girl who manifested signs of hypothalamic disease. The child was admitted to the hospital because of nervousness and precocious development of the breasts together with a moderate growth of pubic hair. Neurological examination was indicative of intracranial hypertension and possibly a posterior fossa lesion but a ventriculogram suggested an obstruction at the foramen of Monro. Exploration of the anterior third ventricle disclosed a discrete hemangioma in that location which was biopsied but not removed. Ventriculo-cisternostomy was subsequently carried out followed by irradiation. With this management the symptoms regressed and the girl remains apparently well to date, three years after operation.

Transorbital Lobotomy

Robert J. Goodall, M.D., Houston, Texas

The transorbital lobotomy was first described by Fiamberti in 1937 and was revised by Walter Freeman in 1946.

Four hundred patients operated by Dr. Freeman have statistically shown encouraging results. Se-

rious complications in the Freeman series were approximately 2½ percent. It is his opinion that the operation is of value in the anxiety state of hypochondriasis, in obsession tension states and involutional depression. Others have reported encouraging results for the relief of pain.

The technique of the operation consists of penetrating the orbital plate and cutting frontal connecting fibers. It has the disadvantage of a very low degree of accuracy.

Recovery from the operation is rapid and the patient can usually return home in a few days. It is felt that the operation has definite value.

Discussion:

Dr. Robertson: Many neurosurgeons have come to the conclusion that much is being lost by prefrontal lobotomy in personality changes. Some compromise should and probably can be made. I have no objection to the procedure that Dr. Freeman more or less invented, but it seems to go against neurosurgical principle in having no visibility of the operative field which is something to be considered.

Dr. Weisz: I have done three myself. I was very enthusiastic about it when it was first introduced. The results vary according to the technique. In seeing the operation performed and doing it myself, I realize the greatest difficulty is in advancing the 5 and 7 centimeters, which is usually done by eye. There is a difference if the eye is completely or partially opened. The most important consideration, however, is the results. In my experience it has done remarkable things for a few days or years, but afterwards the patient returns to the original symptoms, even the same compulsions. That is the reason why, to my way of thinking, there are only two indications for transorbital leucotomy. First, if the patient is a candidate for the classical prefrontal operation, and the transorbital lobotomy is used as a test; and second when used with electroshock. The method of using this method after electroshock was introduced by Freeman. As much enthusiasm as I showed myself when this procedure was first introduced, I feel now with the exception of the two indications mentioned above, I would prefer to continue electroshock and prefrontal lobotomy if indicated.

Dr. Smolik: In 1949 we had occasion to "operate," I use the word with reservation, 100 cases. We closed the door very tightly so our neurosurgical colleagues would not see us. There were three deaths, substantially greater than by direct method, and our results were completely at variance with those published by Dr. Freeman and Dr. Moore. We are going to publish them but are waiting to see what happens in a 3 year follow up. If 5 percent show some improvement, we would consider it fortunate indeed. I believe that the reason these patients show so little traumatic response is that the instrument actually does nothing to the brain. At autopsy it has been pushed through the brain, and then the brain thoroughly sectioned with no trace of the cut found. I think the instrument tends to push the brain. The result in intractable pain, I believe, is better; the psychiatric patient doesn't stand a lobotomy as well. The operative risk is much greater by the transorbital method: in 35 to 50 operations by the standard method there are 3 or 4 deaths; six transorbitals were done with two deaths. I had occasion to hear Dr. Moore who devised this instrument and he thought we were not doing the operation right. He gives it a little hook and twists it, and he gets Area 34.

Dr. Greenwood: I had the pleasure of seeing Dr. Freeman perform this operation. He was not the least bit amused when I suggested he re-name his operation the "partial pith." Neurosurgeons should know the dangers of going into blind fields, inviting disaster.

Dr. Sachs: I agree heartily with Drs. Robertson, Weisz, Smolik, and Greenwood. There are one or two other things to consider: there is the matter of the plane of the bridge of the nose, which seems somewhat arbitrary in this operation. There is too much difference between noses. Using bony landmarks as anatomical guides isn't the best business anyway, and of all bony landmarks, the nose is a pretty poor one. So far as I am aware the brain is not particular from what angle the fibers are sectioned. Either frontal fibers were sectioned, or they were not sectioned. As to mortality, 3 deaths in 500 was Dr. Poppen's figure with the open procedure.

Dr. Fields: In December in New York at the meeting of the Association for Research in Nervous and Mental Diseases, the subject "Treatment in Psychiatry" occupied the entire Saturday afternoon program and was devoted to psychosurgery. Six or eight papers were read by neurosurgeons on various destructive procedures to the frontal lobe, and at the conclusion of the session it was the general impression that actually nobody had offered very much more to these patients than what could be accomplished by sitting down and talking to them.

Dr. Robertson: The problem of intractable pain is a big issue. I doubt if these patients would be satisfied by sitting down and talking. Lobotomy is desirable for these patients.

Dr. Ashkenazy: We have recently operated in six patients with intractable pain. What we have attempted to do is make a minimal lesion at the tip of the needle, and we do this under definite neurosurgical principle with good technique and check with anterior and lateral views at surgery, injecting air into the lateral horn, and with that technique we have created lesions which have caused the least defect. Grantham in Kentucky was the first to do this. We can't completely evaluate this procedure yet; however, there have been minimal personality changes and for the patients with intractable pain complete relief of pain until some advanced metastatic pain. We had one inoperable tumor of the cerebellum in which we obtained complete relief of pain. I think neurosurgeons can use good technique and create minimal lesions.

Dr. Kellaway: The transorbital approach does appear to be less of a traumatizing or defective agent as far as electroencephalographic record goes. I was wondering if there was any truth, then, in the statement that perhaps this instrument doesn't do anything but push around the brain without traumatizing it.

Dr. Picaza: I think everybody in removing focalized lesions agrees that a number of patients do improve in personality. How they improve, we do not know.

Subclavian Artery Bruits: A Contribution to the Study of Neurovascular Compression Syndromes of the Upper Extremity

George Ehni, M.D., Houston, Texas

In recent years a number of additional neurovascular compression mechanisms have been added to the previously recognized cervical rib, scalenus anticus syndrome, and thoracic apex neoplasm syndromes. In addition to the effects of hyperabduction of the arm with or without cervical rib, and of throwing the shoulder backward in normal and abnormal anatomies, it appears that certain patients with Raynaud's phenomenon and thrombosis of the subclavian vein may have costoclavicular mechanisms operating. Compression of the artery seems at least theoretically possible in three locations: Namely, behind the scalenus anterior muscle, between the clavicle and the first thoracic or a su-

pernumerary cervical rib, and below the pectoralis minor insertion on the coracoid process. These newly recognized possibilities make it more imperative than ever that we know what structure or structures are producing the vascular compression, and it is no longer possible to merely relate symptoms to ischemia or plexus compression and show that some one test or the other causes pulse loss.

Bruits have been mentioned in the literature from time to time as occurring over the subclavian artery in certain patients considered to have one form of neurovascular compression or another, but no systematic study of these bruits seems to have been made.

This report concerns a study of 61 patients studied for bruit and pulse loss on maneuver of one sort or the other. Most of these patients had cervicobrachial pain or upper extremity palsies. In 31 of these patients no bruit or pulse loss could be produced by any maneuver. Among this group of negative patients were 18 with cervical disc herniations, and two with cervical ribs, neither productive of symptoms in the present context. Twenty-two patients had arterial compression by maneuver as determined by pulse loss or bruit production, or both. Bruits were heard in only two locations. Those heard on Adson's maneuver were over the medial end of the clavicle, while those heard on hyperabduction and on throwing the shoulder back were heard below the midportion of the clavicle. These bruits were all surprisingly well localized, and nontransmissible, so there was never any difficulty in centering the stethoscope directly over the site of bruit generation. Three of the patients with bruits over the medial end of the clavicle in response to Adson's maneuver had cervical ribs, and all were converted into negative Adson reactors after operation consisting of scalene myotomy or rib removal. Nine patients produced an infraclavicular bruit on hyperabduction. Two of these had cervical ribs and could produce a simultaneous bruit above the medial end of the clavicle if Adson's test was performed while the arm was abducted. Hyperabduction is thought to occlude the pulse between the clavicle and the first rib rather than beneath the pectoralis minor insertion on the coracoid since the bruit was always located at the point where the clavicle opposes the rib in this maneuver, and not in the axilla. Other evidence in the literature also strongly suggests that when the arm is abducted, the clavicle moves to the rear and narrows the space between it and the rib. Four patients were found to have bruit on placing the shoulders in the position of attention, and these bruits too were below the midportion of the clavicle.

To summarize, the bruit studies indicate that the subclavian artery is compressible in at least two different locations: 1) back of the scalene anterior, and 2) between the clavicle and the upper rib. Adson's test reduces the pulse at the scalene only if the factor of the clavicle and rib be eliminated by holding the shoulder well forward on performance of the test. Hyperabduction and shoulder bracing tests occlude the artery between the clavicle and rib behind it. Locating the bruit in the various maneuvers gives valuable information as to which mechanism is operating and what structures need to be dealt with to give relief if surgery is contemplated.

Discussion:

Dr. Sachs: You said that if the bruit is below the clavicle and therefore the compression is between clavicle and rib, the rib should be removed. Do you mean the normal first rib in the absence of a cervical rib?

Dr. Ehni: I suggest that would be the logical procedure. It was reported as having been done by Eden in 1934, where there was dilatation of the subclavian artery between a normal rib and clavicle.

Dr. Picaza: Do you believe that any kind of irritative spasm occurs in the scalenus muscle?

Dr. Ehni: I don't know how currently popular this idea is now but it was proposed by several that cervical root irritations are capable of throwing the scalenus anterior into spasm. This muscle is supposed to have a higher innervation than from roots usually affected by disc herniations. I think Walshe mentioned that. I do not believe the spasm of the scalene is an important factor. These muscles when cut retract in a remarkable fashion but no more than other muscles subjected to the same treatment.

Electroencephalography in the Diagnosis of Cerebral Space-Occupying Lesions

Peter Kellaway, Ph.D., Associate Professor of Physiology and Neuropsychiatry, Baylor University, College of Medicine, Houston, Texas

The purpose of this paper is to attempt to define the parameters of usefulness of electroencephalography in routine neurosurgical practice. The failure of this laboratory tool to take its proper place in the diagnostic armamentum of many neurosurgical services is the direct result of the failure on the one hand of many neurosurgeons to learn the application of the technique, and on the other of electroencephalographers to widen the scope of their interpretation and to offer more than a simple technical "impression" of "focal" or "diffuse" abnormality.

The significance of various findings in relationship to the history and physical examination are discussed. The importance of the correlative type of interpretation is stressed and the value of an adequate history to electroencephalographic interpretation is demonstrated by comparing the impression given in three similar diffusely abnormal electrograms when considered in relation to the history and physical findings in each case.

Correct diagnosis in each of the three cases was made when properly related to the clinical findings. They consisted of a case of midline frontal pole tumor, a tumor of the third ventricle, and a cerebellar tumor. In the complete absence of correlative material evaluation would have been limited in at least two of the cases to a statement that there was a diffuse disturbance of the electroencephalogram and a technical description of the character of this disturbance. It is shown that the variations of such technical factors as phase, continuous or paroxysmal slowing, areal distribution of abnormality, etc. serve to indicate the nature of the pathology, but that it is the sum total of these technical features considered in relation to the clinical picture that makes possible any significant contribution to diagnosis.

The point is stressed that it is rarely possible even when all the facts are available to derive a categorical diagnosis from the electroencephalographic findings. The electroencephalographer's impression should always be expressed in terms of "consistent with" or "compatible with" a given disorder, or, as is sometimes possible, "to favor this diagnosis rather than that." Sometimes when the clinical picture is indefinite it is necessary that the electroencephalographer point out two or three entities with which the findings are possibly consistent. In this way new data may be uncovered in a clinical re-evaluation of the patient. Instances illustrating cases in which such information was important in making a final diagnosis are given.

Discussion:

Dr. Robertson: I have repeatedly said that electroencephalography has not been very useful to me, and it has been my experience that it has not con-

tributed very much in diagnosing or localizing brain tumor.

Dr. Greenwood: I think the place of electroencephalography in brain tumors is still to be worked out. We have gotten essentially useful information. First we had a little fun in trying to prove Dr. Kellaway wrong but he was right so many times. I haven't gotten to the point where I would like to dispense with ventriculography and encephalography, and I think that perhaps the greatest usefulness of EEG lies in the early evidence of brain tumor: sometimes where you would not feel like hospitalizing patients, the performance of an EEG will lead them right to the hospital and removal of a brain tumor. The patient who comes to the office has only suggestive evidence; the EEG turns up some very astounding things and then again at other times we are content to wait.

Dr. Ashkenazy: I believe that any of the neurosurgical tests on their own might prove fallacious. However, as Dr. Kellaway pointed out, if used as an adjunct, it is useful. If you use all the methods there will be a case rarely that you will miss. At V.A. we routinely ask for EEG studies. We give them even though air studies reveal the answer. I like to use EEG and radio dye and air studies and clinical examination in all cases.

Hibicon in the Treatment of Epilepsy*

C. D. Hawkes, M.D., Assistant Professor of Neurology and Instructor in Neurosurgery, University of Tennessee College of Medicine, Memphis, Tennessee

Hibbicon (chloreothylphenamide) is a compound of different chemical nature from other modern anti-convulsant drugs effective in the treatment of convulsive disorders. It is most useful in major seizures, having little effect in petit mal attacks. Adequate control of convulsions was achieved in 39 of 59 patients given clinical trial on Hibicon, supplemented by a barbiturate in 11 instances. Of the 20 cases which failed to respond, eight patients had never been adequately controlled on any anti-convulsant medication. The patients reported in this study have been followed from 6 to 30 months following the institution of treatment with Hibicon.

In a comparative study of a group of 31 patients, 60 per cent were controlled on a hydantoin-barbiturate combination whereas 70 per cent were controlled on Hibicon (with supplementary barbiturates in 7 instances).

The addition of Hibicon to the pharmacological armamentarium for the therapy of chronic epilepsy appears to widen the scope of such therapy, since Hibicon has successfully controlled some patients who failed to respond to all other present day anti-convulsant drugs. It is singularly free from toxic reactions and untoward side effects so that patients who are equally well controlled on this or other anti-convulsant medication feel better on Hibicon.

Discussion:

Dr. Fields: I was delighted to learn that the toxicity in humans is about the same as found in the laboratory. Where you remarked that you gave additional phenobarbital and Dilantin in the case of petit mal, do you intend to indicate that these were classical absence seizures or partial grand mal? Maybe my interpretation is due to a difference in definition, but I think petit mal as being in a specific category.

Dr. Kellaway: Where we had phenobarbital a few years ago, we are now having such a confusing array with conflicting reports and nobody has made any attempt to see what happens and why there is such variance in patients' reactions. I think it would be interesting to find out whether everybody metabolizes these in the same way. One other approach: most of these drugs are evaluated in laboratories and get to the neurologist for clinical use after the kind of testing employed by laboratories where a chemical stimulus is used to provoke seizure. Seizure by definition is a spontaneous affair and we are not looking for drugs that will inhibit by raising the threshold. It would be interesting to study what effect Dilantin would have on fasciculations, on diseases like anterior lateral sclerosis. Perhaps in cases like petit mal we might find a drug which would inhibit changes in the autonomic cell rather than raise the threshold.

Dr. Hawkes: Concerning petit mal, I think we probably use that term in a general sense. When the patients were suffering grand mal attacks and our medicine stopped those, but they still suffered minor seizures, we gave them barbiturates.

As for the laboratory technique in the analysis of a new compound, we have to have some method of screening drugs and determining the various characteristics. Probably some more physiologic methods would be desirable if practical. The EEG changes were recorded on some and we hope to make more and have EEG series on all of these patients. We expect we have found the general change lagging toward a more normal record than has previously been experienced.

We have not employed the combination of hydantoin compounds with Hibicon but in Chicago it has been done with some success and we feel that patients should be subjected to this combination and probably will be in the future, but we don't want to go off in too many directions before it is proven clinically practical.

Now I will ask a question myself. When will the drug be available? There should be some word within the next few weeks as to whether it may be released. We have completed over three years' study on this, and all our work has taken place after the animal experimentation had been done.

*From the Department of Neurology, University of Tennessee College of Medicine, Memphis, Tennessee.

Meeting of German Societies

The German Society of Neurology, the German Society of Neurosurgery, and the German Society of Neurologists and Psychiatrists will hold a combined meeting in Munich August 26-29, 1953. On the first day the subject will be: Technique of Narcosis, on the second: Meningitis, and on the third: Development of Psychiatry in the United States During the Last Three Decades. Psychodiagnostics will be the subject for the last day. The German Neuropathological Society will hold its meeting in Munich concurrently, August 26-27. Subject: Cerebellum. For information: Dr. Ehrhardt, Univ.-Nervenklinik, Marburg/Lahn, Germany.

Prizes for Dissertations on Epilepsy

The American League Against Epilepsy announces an extension of the time limit for submission of dissertations for the Jerry Price Memorial Prizes from April 1st to July 1st, 1953. The prizes will be awarded for the best dissertation on any aspect of epilepsy submitted by students of approved medical schools in the United States and Canada.

First Prize is $500. Other prizes up to a total of $1000 will be awarded.

Inquiries may be addressed to any member of the Prize Committee: William G. Lennox, M.D., 300 Longwood Avenue, Boston 15, Mass.; Francis L. McNaughton, M.D., 3801 University Street, Montreal 2, Canada; John L. Otto, M.D., 816 Strand, Galveston, Texas.